THIRD EDITION

THE PEARSON GUIDE TO

# QUANTITATIVE APTITUDE

## for Competitive Examinations

**Questions from last 10 years' papers of SSC, Banking, LIC and other Competitive Examinations**

**Over 8000 fully solved questions**

**Short cut methods included**

Dinesh Khattar

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The Pearson Guide to

# Quantitative Aptitude

*For Competitive Examinations*

(Third Edition)

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PEARSON

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# Preface to the Third Edition

It gives me great pleasure to present to the readers the third edition of the book. In this edition, a large number of problems that have been asked in the recent competitive examinations are included in every chapter with explanatory answers. In order to provide a more focused approach, the obsolete previous years' questions have been deleted in every chapter.

In preparing this third edition, I am greatly indebted to many teachers at various coaching centers as wells students throughout the country who made constructive criticism and extended valuable suggestions for the improvement of the book. Any suggestions to ensure further improvement of the book will be greatly acknowledged.

I am extremely thankful to editorial team of Pearson Education, especially to Sharel Simon and G. Sharmilee for their unfailing cooperation.

Dinesh Khattar

# Preface to the First Edition

With so many books available in the market on quantitative aptitude for students appearing in different competitive examinations, the publication of yet another volume on the subject requires some explanation. It has been my experience that the average student needs the treatment of theory in a manner easily understandable to him. An effort, therefore, has been made, in this book to put across concepts in a lucid and unambiguous manner. The book aims at helping students enhance their knowledge of quantitative aptitude and equipping them with the skills that will enable them to succeed in any competitive examination.

The book is noteworthy in the following aspects:

1. Each chapter contains concise definitions and explanations of basic/fundamental principles, which are further augmented with illustrative examples to enable students to learn and recall fast.
2. Each chapter has a separate section on short-cut methods covering all kinds of questions asked in competitive examinations. In addition, each short-cut method is explained with the help of illustrative examples.
3. Completely worked-out solutions to a large range of problems have been included in the text. The number of questions in each chapter has been kept sufficiently large to provide rigorous practice.
4. A large number of problems that have been asked in the competitive examinations in recent times are included in every chapter with explanatory answers.
5. Practice exercises covering all the topics in each chapter are provided for self-assessment and to facilitate understanding of the pattern and the type of questions asked in the examinations.

Every care has been taken to minimise typographical as well as factual errors. However, it is possible that a few errors might have managed to dodge the vigilant eye. I will be grateful to the readers for bringing these errors to my notice as also for their valuable suggestions. It is earnestly hoped that the book will help the students grasp the subject and help them in obtaining a commendable score in the examination.

In preparing this edition, my deepest appreciation goes to many teachers at various coaching centres as well as students throughout the editorial who made constructive criticism and extended valuable suggestions. I am also extremely thankful to Pearson editorial team, for their unfailing cooperation.

I am deeply indebted to my parents without whose encouragement this dream could not have been translated into reality. And last, but not the least, it was the cherubic smiles of my daughters Nikita and Nishita that inspired me to treat my work as worship.

Dinesh Khattar

# Acknowledgement

I would like to express my gratitude to my father to whom I owe all my achievements. Whatever I have achieved in life is because of the dreams and wishes which he has always nurtured about me.

# COMPETITIVE EXAMINATIONS: AN OVERVIEW

## DEFENCE SERVICES EXAMINATIONS

### COMBINED DEFENCE SERVICES EXAMINATION

Combined Defence Services examination is conducted by the Union Public Service Commission (UPSC) twice every year for recruitment to the officer cadres of the Army, Navy and Air Force. The CDS examination is conducted generally in the months of May and October.

#### Age

*For IMA:* Unmarried male candidates between 19 and 24 years on 1 January or 1 July of the year succeeding the year of examination.

*For Naval Academy:* Unmarried male candidates between 19 and 22 years on 1 January or 1 July of the year succeeding the year of examination.

*For Air Force Academy:* Unmarried male candidates between 19 and 23 years on 1 January or 1 July of the year succeeding the year of examination.

*For Officers Training Academy:* Male candidates (married or unmarried) between 19 and 25 years on 1 January or 1 July of the year succeeding the year of examination.

#### Educational Qualifications

- For IMA/OTA: A degree from a recognised university or equivalent.
- For Naval Academy: B.Sc. with physics and/or mathematics or a Bachelor of Engineering degree.
- For Air Force Academy: B.Sc. from a recognised university or equivalent with physics and/or mathematics as subjects or a BE degree.

#### Examination

**Plan of the Examination:** The examination comprises (a) written examination and (b) interview for intelligence and personality test of such candidates as may be called for interview at one of the Services Selection Centres.

**Examination Subjects:** The following will be the subjects for the written examination (each of 2 hours duration):

(a) For admission to Indian Military Academy, Naval Academy and Air Force Academy:
English—This paper tests the understanding of the English language.
General Knowledge—This tests the general knowledge, current events, history, Indian geography, and other matters of everyday observation.
Elementary Mathematics—This paper covers arithmetic, algebra, geometry, trigonometry, and statistics.

(b) For admission to Officers Training Academy (OTA):
English—This paper tests the understanding of the English language.
General Knowledge—This tests the general knowledge, current events, history of India, geography of nature and other matters of everyday observation.

**Notes**

(i) The papers in all subjects will consist of objective-type (multiple-choice) questions only. The question papers will be set in English only.

(ii) Each paper will be of 2 hours duration and will carry 100 marks.

**Standard of Examination:** The standard of the paper in Elementary Mathematics will be of the matriculation examination. The standard of papers in other subjects will approximately be such as may be expected of a graduate of an Indian university.

**Syllabus for Elementary Mathematics:** Arithmetic—number system, natural numbers, integers, rational and real numbers, fundamental operations—addition, subtraction, multiplication, division, square roots, decimal fractions. Unitary method—Time and distance, time and work, percentage, applications to simple and compound interest, profit and loss, ratio and proportion, variation. Elementary Number Theory—Division algorithm, prime and campsite number, test of divisibility by 2, 3, 4, 5, 9 and 11, multiples and factors, factorisation theorem, H.C.F. and L.C.M. Algebra—Basic operations, simple factors, remainder theorem, H.C.F., L.C.M., theory of polynomials, solutions of quadratic equations. Simultaneous linear equations in two unknowns—analytical and graphical solutions. Simultaneous linear inequations in two variables and their solutions. Practical problems leading to two simultaneous linear equations or inequations in two variables or quadratic equations in one variable and their solutions. Set language and set national, rational expressions and conditional identities, laws of indices. Trigonometry—sine$x$, Cosine$x$, Tangent$x$ when 0° £ × £ 90°. Values of sin$x$, cos$x$ and tan$x$, for $x$ = 0°, 30°, 45°, 60° and 90°. Simple trigonometric identities. Use of trigonometric tables. Simple cases of heights and distances. Geometry—Lines and angles, Plane and plane figures. Theorems on (a) properties of angles at a point, (b) parallel lines, (c) sides and angles of a triangle, (d) congruency of triangles, (e) similar triangles, (f) concurrence of medians and altitudes, (g) properties of angles, sides and diagonals of a parallelogram, rectangle and square, (h) circle and its properties, including tangents and normals, and (i) loci. Mensuration—Areas of squares, rectangles, parallelograms, triangle and circle. Areas of figures, which can be split up into the figures (field book). Surface area and volume of cuboids, lateral surface and volume of right circle cones and cylinders. Surface area and volume of spheres. Statistics—Collection and tabulation of statistical data. Graphical representation—frequency polygons, histograms, bar charts, pie charts, etc. Measures of central tendency.

## NDA ENTRANCE EXAMINATION

Recruitment of candidates to Army, Navy and Air Force wings of the National Defence Academy (NDA), is through National Defence Academy Entrance Examination which is held twice a year, generally in the month of April and September. NDA examination is conducted by the UPSC.

### Age

A candidate must be an unmarried male and have attained the age of 16½ years and must not have attained the age 19 years on the 1st January or 1st of July of the year succeeding the year of examination.

### Educational Qualifications

- For Army Wing of National Defence Academy: 12th Class pass of 10 + 2 pattern of School Education or equivalent examination conducted by a State education Board or a University.
- For Air Force and Naval Wings of National Defence Academy and for the 10 + 2 (Executive Branch) course at the Naval Academy: 12th Class pass of the 10 + 2 pattern of a School Education or equivalent with Physics and Mathematics conducted by a State Education Board or a University. Candidates who are appearing in the 12th Class under the 10 + 2 pattern of School Education or equivalent examination can also apply.

### Examination

**Plan of the Examination:** The examination comprises (i) written examination and (ii) intelligence, obstacles and group tests of the candidates qualifying the written examination.

**Examination Subjects:** The subjects of the written examination, the time allowed and the maximum marks allotted to each subject are as follows:

| *S.No.* | *Subject* | *Duration* | *Max. Marks* |
|---|---|---|---|
| 1. | Mathematics | $2\frac{1}{2}$ hours | 300 |
| 2. | General Ability Test (English, GK and Science) | $2\frac{1}{2}$ hours | 600 |
| | Total | | 900 |

***Notes***

- The papers in all subjects will consist of objective-type questions only.
- The question papers (test booklets) will be set in English only.

**Syllabus of Arithmetic:** Number Systems—natural numbers, integers, rational and real numbers. Fundamental operations—addition, subtraction, multiplication, division, square roots, decimal fractions. Unitary method—time and distance, time and work. Percentage—applications to simple and compound interest, profit and loss, ratio of proportion, variation. Elementary number theory, division algorithm prime and composite numbers. Tests of divisibility by 2, 3, 4, 6, 9, and 11. Multiples and factors. Factorisation theorem. H.C.F. and L.C.M. Euclidean algorithm. Logarithms to base 10, laws of logarithms. Mensuration—areas of squares, rectangles, parallelograms, triangle and circles. Area of figures, which can be split up into these figures (field book). Surface area and volume of cuboids, lateral surface and volume of right circular cones and cylinders. Surface area and volume of spheres. Algebra—basic operations, simple factors, remainder theorem, H.C.F., L.C.M. of polynomials. Solutions of quadratic equations, relation between its roots and coefficients (only real roots to be considered). Simultaneous linear equations to two unknown analytical and graphical solutions. Practical problems leading to two simultaneous linear equations in two variable or quadratic equations in one variable and their solutions. Set language and set nation. Rational expression and conditional identities. Law of indices. Geometry—lines and angles. Plane and plane figure. Theorems on properties of angles at a point, parallel lines, sides and angles of a triangle, congruency of triangles, similar triangles, concurrence of medians and altitudes, properties of angles, sides and diagonals of a parallelogram, rectangle and square, circles and their properties including tangents and normals, loci. Trigonometry—sine$x$, cosine$x$, tangent$x$ when 0° £ × £ 90°. Value of sin$x$, cos$x$ and tan$x$ for $x$ = 0°, 30°, 45°, 60 and 90°. Simple trigonometric identities. Use of trigonometrical tables. Simple cases of heights and distances. Statistics—Collection and tabulation of statistical data. Graphical representation, frequency polygons, histograms, bar charts, pie charts, etc. Calculation of mean of raw and grouped data.

# SSC Competitive Examinations

## Scheme of the Examination for Combined Graduate Level Examinations

The Scheme of the Examination will be conducted in three tiers as indicated below:

- *1st Tier-I* Written Examination (Objective Multiple Choice Type)
- *2nd Tier-II* Main Written Examination (Objective Multiple Choice Type)
- *3rd Tier-III* Personality Test/Interview or Skill Test, where applicable Candidates opting for post of Sub-Inspector in CPOs will be required to undergo Physical Endurance Test (PET)/Medical Examination at any convenient time after declaration of result of Tier-I.

### COMBINED GRADUATE LEVEL (TIER-I) EXAMINATION

Tier-I of the Combined Graduate level Examination would be common for all categories of posts and will be held in one session. Total duration of the examination = 2 hours.

| Part | Subject | Maximum Marks/Questions |
|---|---|---|
| I | General Intelligence and Reasoning | 50 |
| II | General Awareness | 50 |
| III | Numerical Aptitude | 50 |
| IV | English Comprehension | 50 |

**Syllabus of Numerical Aptitude:** The questions are designed to test the ability of appropriate use of numbers and number sense of the candidate. It will test sense of order among numbers, ability to translate from one name to another, sense or order of magnitude, estimation or prediction of the outcome of computation, selection of an appropriate operation for the solution of real life problems and knowledge of alternative computation procedures to find answers. The questions would also be based on arithmetical concepts and relationship between numbers and not on complicated arithmetical computation (The standard of the questions will be of 10 + 2 level).

## COMBINED GRADUATE LEVEL (TIER-II) EXAMINATION

Tier-II of the Combined Graduate Level Examination is an objective multiple-choice and is conducted over two days during a weekend. It will consist of three different papers/subjects and depending upon the category of posts applied for, the candidate will be required to appear in one, two or three papers, as the case may be.

**For the post of Assistants, Inspector of Income Tax/Inspector (Central Excise, Inspector (PO), Inspector (Examiner), Sub Inspector in CBI, Inspector of Posts, Assistant Enforcement Officer, Divisional Accountants, Accountants, Auditors, Tax Assistants, UDCS, the examination will consist of two papers as under:**

| Part | Subject | Maximum Marks/Questions | Duration For General Candidates | Duration For Vh Candidates |
|---|---|---|---|---|
| I | Arithmetical Ability | 200/100 | 2 Hours | 2 Hours and 40 Minutes |
| II | English Language and Comprehension | 200 | 2 Hours | 2 Hours and 40 Minutes |

**For the post of Statistical Investigators GR.II & Compilers, the examination will consist of three papers as under:**

| Part | Subject | Maximum Marks/Questions | Duration For General Candidates | Duration For Vh Candidates |
|---|---|---|---|---|
| I | Arithmetical Ability | 200/100 | 2 Hours | 2 Hours and 40 Minutes |
| II | English Language and Comprehension | 200/200 | 2 Hours | 2 Hours and 40 Minutes |
| III | Commerce/Mathematics Statistics/Economics | 200/200 | 2 Hours | 2 Hours and 40 Minutes |

**For The post of Sub-Inspector in Central Police Organisations, the examination will consist of one Paper as under:**

| Paper | Subject | Maximum Marks/Questions | Duration For General Candidates |
|---|---|---|---|
| I | English Language and Comprehension | 200/200 | 2 Hours |

**Syllabus For Tier-II (Paper-I):** Arithmetic Ability—This paper will include questions on problems relating to Number Systems, Computation of Whole Numbers, Decimals and Fractions and relationship between Numbers, Fundamental Arithmetical Operations, Percentage, Ratio and Proportion, Average, Interest, Profit and Loss, Discount, Use of Table and Graphs, Mensuration, Time and Distance, Ratio and Time, etc.

## CLERKS' GRADE EXAMINATION

Clerks Grade Examination is conducted by the Staff Selection Commission for recruitment to the posts of clerks for the following groups of services/offices:

*Group X*

- Indian Foreign Service (B) Grade VI
- Railway Board Secretarial Clerical Service Grade II
- Central Secretariat Clerical Service—Lower Division Grade
- Armed Forces Headquarters Clerical Service—Lower Division Grade
- Ministry of Parliamentary Affairs
- President's Secretariat

*Group Y*

- Equivalent/comparable posts in Subordinate offices of Government of India located throughout India.
- Offices of the Controller and Auditor General of India, Accountants General (Audit) and Accountants General (Accounts and Estt.) in various states.
- Controller General of Defence Accounts.
- Central Vigilance Commission.
- Equivalent/comparable posts in other Departments and Attached Offices of Government of India not mentioned in group 'X'.
- Equivalent/comparable posts in the offices of public sector undertakings, autonomous bodies, like Employees State Insurance Corporation
- Delhi Administration
- Municipal Corporation of Delhi and New Delhi Municipal Corporation
- University of Delhi

### Age

18 to 25 years on the 1st August of the year of examination. Upper age limit relaxable for SC/ST etc.

### Educational Qualifications

Matriculation or equivalent.

### Examination

**Plan of the Examination:** The examination shall consist of two parts. Part I-Written Examination and Part II-Typewriting Test for those candidates who attain such minimum standards in the written test as may be fixed by the commission in their discretion.

**Examination Subjects:** The subjects of written examination, the time allowed and the maximum marks for each subject will be as follows:

| S.No | Subject | Duration | Max. Marks |
|---|---|---|---|
| 1 | General Intelligence and Clerical Aptitude | 2 Hours | 50 |
| 2 | English Language | | 50 |
| 3 | Numerical Aptitude | | 50 |
| 4 | General Awareness | | 50 |

*Notes*

(i) The questions in all the four tests will be Objective-Multiple Choice Type.
(ii) Candidates will be required to qualify in each of the tests separately.

**Syllabus of Numerical Aptitude Test:** Questions will be designed to test the ability of arithmetical computation of whole numbers, decimals and fractions and relationship between numbers. The questions would be based on arithmetical concepts and relationship between numbers and not on complicated arithmetical computation.

# L.I.C/G.I.C. Competitive Examinations

## L.I.C. OFFICERS' EXAMINATION

A competitive examination for the recruitment of the Assistant Administrative Officers etc, in Life Insurance Corporation (LIC) it is held once a year, generally in the month of June. The blank application form and particulars are published in the Employment News, usually the second week of May every year.

### Age

21 to 28 years on the 1st April of the year of examination. Upper age limit is relaxable for SC/ST, confirmed L.I.C. employees, etc.

### Educational Qualifications

Bachelor's/Master's Degree from a recognised Indian or Foreign University with a minimum of 50% marks (relaxable in the case of SC/ST candidates to 40%) in aggregate in either of the degrees.

### Examination

**Plan of the Examination:** The examination comprises (*i*) written examination and (*ii*) interview of candidates who qualify in the written test.

**Examination Subjects:** The written examination consists of the following papers:

*Paper I (Objective)*

1. Reasoning Ability (Bilingual)
2. General Knowledge and Current Affairs (Bilingual)
3. Numerical Ability (Bilingual): The purpose of this test is to ascertain how quick you are in working at numerical calculations
4. English Language with special emphasis on grammar and vocabulary

*Paper II (Descriptive)*

1. Test on Essay (can be written in Hindi or English)
2. Precise and Comprehension in English

## LIC DEVELOPMENT OFFICERS' EXAMINATION

A competitive examination for the recruitment of Assistant Development Officers' in the Life Insurance Corporation is held once a year, generally in the month of September. The blank application forms and particulars are published in the Employment News, generally in the month of July and the last date for submission of applications is generally the first week of August.

### Age

The applicants should have completed the age of 21 years on the 1st July of the year of examination.

### Educational Qualifications

Candidates must hold a bachelor's degree in arts, science, commerce, agriculture or law of an Indian or foreign university or an equivalent qualification.

### Examination

**Plan of the Examination:** The examination comprises (*i*) written examination (*ii*) interview of such candidates, who qualify in the written test.

**Examination Subjects:** The written test will consist of (*i*) test of reasoning and numerical ability and (*ii*) general English/Hindi and general knowledge. The test papers will be set bilingual and the candidates will have choice to write answers either in English or in Hindi.

## G.I.C. ASSISTANTS' EXAMINATION

This examination is held once a year, generally in the month of August. The blank application and particulars are published in the Employment News, usually in the month of March. The last date for the submission of applications is usually first week of April every year.

### Age

18 to 28 years on 1 June of the year of examination.

### Educational Qualifications

Pass in higher secondary with 60% marks or graduate of a recognised university.

### Examination

**Plan of the Examination:** The examination comprises (*i*) written examination and (*ii*) interview of candidates qualifying the written test.

**Examination Subjects:** (*i*) The written test will be objective type, consisting of test of reasoning, numerical ability, clerical aptitude, English language and general knowledge. (*ii*) There will also be a descriptive test on essay, letter and precise writing in English. Objective tests except English will be bilingual, i.e., both in English and Hindi.

# BANKING SERVICES EXAMINATIONS

Banking has emerged as one of the most challenging sectors in the country. Openings are available at various levels, from bank clerical to probationary officers (PO). Recruitment for the public sector banks is done through the Banking Service Recruitment Boards (BSRBs). The advertisements for recruitment appear in newspapers as well as the *Employment News*. Recruitment is done on the basis of a written test, which consists of (*a*) test of reasoning, (*b*) quantitative aptitude, (*c*) general awareness, (*d*) English language and (*e*) descriptive test.

The test is qualifying in nature and the marks obtained are not added in the final merit list. It is held on Sundays. Except for the descriptive portion, all other sections contain objective-type questions. In the reasoning test, there are verbal and non-verbal sections. In English, the test is aimed at judging the overall comprehension and understanding of the language. The descriptive paper can be answered in English or Hindi. It judges the written expression of the candidates. All sections must be qualified.

### Reserve Bank of India

## STAFF OFFICERS' GRADE-A EXAMINATION

Selection for this class I post is made on all-India basis by Reserve Bank of India Services Board, Hong Kong Building, 6th Floor, M.G. Road, P.O. Box 10009, Hutatma Chow, Mumbai 400 001. Set up in July 1968, the Board functions on the lines of the UPSC and conducts various examinations for recruitment of officers grade. There is reservation of posts for SC/ST categories.

### Age

21–26 years

### Educational Qualifications

Bachelor's/Master's Degree (50%) or Chartered/Cost Accountant with Bachelor's Degree or Degree in Management.

### Examination

**Subjects:** Written test consists of

(i) *Paper I* (Objective Type)—Test of reasoning, test of quantitative aptitude, test of English language, general awareness.
(ii) *Paper II* (Descriptive Type)—English essay, precise writing/comprehension.
(iii) *Paper III* (Descriptive Type)—Economic and social problems. Those who qualify the written test are called for interview.

## STAFF OFFICER GRADE B EXAMINATION

### Age

21–28 years (maximum 26 years for degree holders). Relaxable by 5 years for SC/ST and Ex-Servicemen, and by 3 years for OBC candidates.

### Educational Qualifications

Min 60% marks (50% for SC/ST candidates) in bachelor's degree as well as in 10th and 12th Standard.

### Examination

**Subjects:** Written test consists of

(i) *Phase 1: Paper I* (Objective Type)—Test of Reasoning, Quantitative Aptitude, General Awareness and English Language. Phase 2: *Paper I*—English (writing skills); *Paper II—Economic* and Social Issues*; Paper III (optional)*—Finance and Management/ Economics/ Statistics.

***Note***

Written test is followed by interview which carries 50 marks.

### State Bank Group

## PROBATIONARY OFFICERS' EXAMINATION

This examination is held by Central Recruitment Board (State Bank Group) Madhuli, Second Floor, H/2 Shiv Nagar Estate, Dr. Annie Besant Road, Worli, Mumbai 400 018 for recruitment of Probationary Officers in State Bank of India and its associates banks, namely, State Bank of Bikaner and Jaipur, State Bank of Hyderabad, State Bank of Indore, State Bank of Mysore, State Bank of Patiala, State Bank of Saurashtra and State Bank of Travancore. There is reservation of posts for SC/ST, Ex-Servicemen, OBC, etc.

### Age

18–26 years, relaxable for SC/ST, OBC and Ex-Servicemen

### Educational Qualifications

Degree

### Examination

**Subjects:** Written test consists of

(i) *Paper I* (Objective Type)—Test of Reasoning Ability, Quantitative Aptitude, English Comprehension, General Awareness.
(ii) *Paper II* (Descriptive Type)—Essay, letter writing or precise writing in English.

***Note***

Those who qualify the written test are called for interview.

## CLERICAL CADRE EXAMINATION (REGIONAL RECRUITMENT BOARD)

This examination is generally held annually to recruit the clerical cadre in State Bank of India and its associate banks. There is resonation of posts for SC/ST, Ex-Servicemen and OBC, etc.

### Age

18–26 years, relaxable for various categories as per rules.

### Educational Qualifications

Degree

### Examination

**Subjects:** Written test consists of

(i) *Paper I*—General Awareness, Reasoning Ability, English Language, Numerical Ability
(ii) *Paper II*—Essay writing, Letter writing, Precise writing

### NATIONALIZED BANKS

In nationalized banks, the recruitment is made through competitive test held by Banking Service Recruitment Board.

## PROBATIONARY OFFICERS EXAMINATION

There are 15 Banking Service Recruitment Boards in the country. These Boards recruit probationary officers and clerical cadre for the nationalised banks. There is reservation of posits for SC/ST, Ex-Servicemen, etc.

### Age

21–28 years, relaxable for SC/ST, OBC and Ex-Servicemen

### Educational Qualifications

Degree

### Examination

**Subjects:** Written test consists of

(i) *Paper I* (Objective Type)—Test of reasoning ability, quantitative aptitude, English comprehension, general awareness.
(ii) *Paper II* (Descriptive Type)—Essay (in English or regional language), letter writing or precise writing in English.

## CLERICAL CADRE EXAMINATION

### Age

18–26 years, relaxable for certain categories as per rules.

### Educational Qualifications

*For Clerks, Typists*—Degree or 10 + 2 (50%) or diploma in banking (50%) or matriculation (60%).

*For Stenographers*—matriculation.

Relaxation in percentage of marks in qualifying examination for SC/ST, Ex-Servicemen and physically handicapped.

### Examination

**Subjects:** Written examination (200 marks)

(i) *Paper I* (Objective Type)—Reasoning Ability, English language, Numerical Ability, Clerical Aptitude
(ii) *Paper II* (Descriptive Type)—Three out of four questions of short essay or exposition type on a given proposition, situation to be answered in Hindi or English.

For the posts of typists and stenographers, proficiency in typing and shorthand with the following minimum speed is required:

(i) English typing speed 30 wpm
(ii) English shorthand speed 80 wpm
(iii) Hindi typing speed 25 wpm
(iv) Hindi shorthand speed 60 wpm

Proficiency test for typist/stenographer is held if they qualify the written test. Those ranking high in the written examination are called for an interview (100 marks). Final selection is on the basis of candidate's performance in written tests and interview taken together. Probationary period is six months.

## National Bank for Agriculture and Rural Development (NABARD)

## DEVELOPMENT OFFICER GRADE B EXAMINATION

### Age

24–32 years, relaxable for certain categories as per rules

### Educational Qualifications

Master's Degree in economics/agricultural economics (50%), Ph.D is desirable

### Examination

**Subjects:** Written test consists of

*Preliminary examination (objective type):* General Awareness, English Language, Quantitative Aptitude, Reasoning Ability.

*Main examination:*

(i) *Paper I*—General English and General Awareness
(ii) *Paper II*—Economic and Social Problems
(iii) *Paper III*—Economics/Agricultural Economics

## ASSISTANT DEVELOPMENT OFFICER GRADE 'A' EXAMINATION

### Age

21–26 years. Relaxable for certain categories as per rules.

### Educational Qualifications

Bachelor's Degree/Master's Degree (50%)

### Examination

**Subjects:** Written test consists of

*Preliminary Examination* (Objective Type)—General Awareness, English Language, Quantitative Aptitude, Reasoning Ability.

*Main Examination:*

(i) *Paper I*—General English and General Awareness.
(ii) *Paper II*—Economic and Social Problems.

# Numbers

# 1

## INTRODUCTION

In Hindu Arabic System, we use ten symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 called *digits* to represent any number. This is the *decimal system* where we use the numbers 0 to 9. 0 is called *insignificant digit* whereas 1, 2, 3, 4, 5, 6, 7, 8, 9 are called *significant digits*.

A group of figures, denoting a number is called a *numeral*. For a given numeral, we start from extreme right as Unit's place, Ten's place, Hundred's place and so on.

**Illustration 1:** We represent the number 309872546 as shown below:

| Ten Crore $10^8$ | Crores $10^7$ | Ten Lakhs (million) $10^6$ | Lakhs $10^5$ | Ten Thousand $10^4$ | Thousand $10^3$ | Hundred $10^2$ | Ten's $10^1$ | Units $10^0$ |
|---|---|---|---|---|---|---|---|---|
| 3 | 0 | 9 | 8 | 7 | 2 | 5 | 4 | 6 |

We read it as

'Thirty crores, ninety-eight lakhs, seventy-two thousands five hundred and forty-six.'

In this numeral:

The place value of 6 is $6 \times 1 = 6$

The place value of 4 is $4 \times 10 = 40$

The place value of 5 is $5 \times 100 = 500$

The place value of 2 is $2 \times 1000 = 2000$ and so on.

The face value of a digit in a number is the value itself wherever it may be.

Thus, the face value of 7 in the above numeral is 7. The face value of 6 in the above numeral is 6 and so on.

## NUMBER SYSTEM

### Natural Numbers

Counting numbers 1, 2, 3, 4, 5, ... are known as *natural numbers*.

The set of all natural numbers can be represented by

$$N = \{1, 2, 3, 4, 5, ...\}$$

### Whole Numbers

If we include 0 among the natural numbers, then the numbers 0, 1, 2, 3, 4, 5, ... are called *whole numbers*.

The set of whole numbers can be represented by

$$W = \{0, 1, 2, 3, 4, 5, ...\}$$

Clearly, every natural number is a whole number but 0 is a whole number which is not a natural number.

### Integers

All counting numbers and their negatives including zero are known as *integers*.

The set of integers can be represented by

$Z$ or $I = \{..., -4, -3, -2, -1, 0, 1, 2, 3, 4, ...\}$

#### *Positive Integers*

The set $I^+ = \{1, 2, 3, 4, ....\}$ is the set of all *positive integers*. Clearly, positive integers and natural numbers are synonyms.

#### *Negative Integers*

The set $I^- = \{-1, -2, -3, ...\}$ is the set of all *negative integers*. 0 is neither positive nor negative.

#### *Non-negative Integers*

The set $\{0, 1, 2, 3, ...\}$ is the set of all *non-negative integers*.

### Rational Numbers

The numbers of the form $\frac{p}{q}$, where $p$ and $q$ are integers and $q \neq 0$, are known as *rational numbers*, e.g., $\frac{4}{7}$, $\frac{3}{2}$, $-\frac{5}{8}$, $\frac{0}{1}$, $-\frac{2}{3}$, etc.

The set of all rational numbers is denoted by $Q$.

That is, $Q = \{x{:}x = \frac{p}{q};\ p, q \in I, q \neq 0\}$

Since every natural number '$a$' can be written as $\frac{a}{1}$, every natural number is a rational number. Since 0 can

be written as $\frac{0}{1}$ and every non-zero integer '$a$' can be written as $\frac{a}{1}$, every integer is a rational number.

Every rational number has a peculiar characteristic that when expressed in decimal form is expressible either in terminating decimals or in non-terminating repeating decimals.

For example, $\frac{1}{5}=0.2$, $\frac{1}{3}=0.333...$, $\frac{22}{7}=3.1428714287$, $\frac{8}{44}=0.181818$ ..., etc.

The recurring decimals have been given a short notation as

$$0.333... = 0.\overline{3}$$
$$4.1555... = 4.0\overline{5}$$
$$0.323232... = 0.\overline{32}$$

### Irrational Numbers

Those numbers which when expressed in decimal form are neither terminating nor repeating decimals are known as *irrational numbers*, e.g., $\sqrt{2}, \sqrt{3}, \sqrt{5}, \pi$, etc.

Note that the exact value of $\pi$ is not $\frac{22}{7} \cdot \frac{22}{7}$ is rational while $\pi$ is irrational number. $\frac{22}{7}$ is approximate value of $\pi$. Similarly, 3.14 is not an exact value of it.

### Real Numbers

The rational and irrational numbers combined together to form *real numbers*, e.g., $\frac{13}{21}, \frac{2}{5}, -\frac{3}{7}, \sqrt{3}, 4+\sqrt{2}$, etc. are real numbers.

The set of all real numbers is denoted by R.

Note that the sum, difference or product of a rational and irrational number is irrational, e.g., $3+\sqrt{2}$, $4-\sqrt{3}$, $\frac{2}{5}-\sqrt{5}$, $4\sqrt{3}$, $-7\sqrt{5}$ are all irrational.

### Even Numbers

All those numbers which are exactly divisible by 2 are called *even numbers*, e.g., 2, 6, 8, 10, etc., are even numbers.

### Odd Numbers

All those numbers which are not exactly divisible by 2 are called *odd numbers*, e.g., 1, 3, 5, 7, etc., are odd numbers.

### Prime Numbers

A natural number other than 1, is a *prime number* if it is divisible by 1 and itself only.

For example, each of the numbers 2, 3, 5, 7, etc., are prime numbers.

### Composite Numbers

Natural numbers greater than 1 which are not prime, are known as composite numbers.

For example, each of the numbers 4, 6, 8, 9, 12, etc., are composite numbers.

***Notes:***

1. The number 1 is neither a prime number nor a composite number.
2. 2 is the only even number which is prime.
3. Prime numbers up to 100 are:
   2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97, i.e., 25 prime numbers between 1 and 100.
4. Two numbers which have only 1 as the common factor are called *co-primes* or *relatively prime* to each other, e.g., 3 and 5 are co-primes.

Note that the numbers which are relatively prime need not necessarily be prime numbers, e.g., 16 and 17 are relatively prime, although 16 is not a prime number.

## ADDITION AND SUBTRACTION (SHORT-CUT METHODS)

The above method is best illustrated with the help of following example:

**Illustration 2:** 54321 – (9876 + 8967 + 7689) = ?

$$\begin{array}{r} 54321 \\ \left.\begin{array}{r} 9876 \\ 8967 \\ 7689 \end{array}\right\} \\ \hline 27789 \\ \hline \end{array}$$

**Step 1** Add Ist column:

6 + 7 + 9 = 22

To obtain 1 at unit's place add 9 to make 31. In the answer, write 9 at unit's place and carry over 3.

**Step 2** Add 2nd column:

3 + 7 + 6 + 8 = 24

To obtain 2 at ten's place, add 8 to make 32. In the answer, write 8 at ten's place and carry over 3.

**Step 3** Add 3rd column:

3 + 8 + 9 + 6 = 26

To obtain 3 at hundred's place, add 7 to make 33. In the answer, write 7 at hundred's place and carry over 3.

**Step 4** Add 4th column:

$$3 + 9 + 8 + 7 = 27$$

To obtain 4 at thousand's place, add 7 to make 34. In the answer, write 7 at thousand's place and carry over 3.

**Step 5** 5th column:

To obtain 5 at ten-thousand's place add 2 to it to make 5. In the answer, write 2 at the ten-thousand's place.

$\therefore$ $54321 - (9876 + 8967 + 7689)$

$= 27789.$

## MULTIPLICATION (SHORT-CUT METHODS)

1. Multiplication of a given number by 9, 99, 999, etc., that is by $10^n - 1$

*Method*: Put as many zeros to the right of the multiplicant as there are nines in the multiplier and from the result subtract the multiplicant and get the answer.

**Illustration 3:** Multiply:

(a) 3893 by 99 (b) 4327 by 999

(c) 5863 by 9999

**Solution:** (a) $3893 \times 99 = 389300 - 3893 = 385407$

(b) $4327 \times 999 = 4327000 - 4327 = 4322673$

(c) $5863 \times 9999 = 58630000 - 5863 = 58624137$

2. Multiplication of a given number by 11, 101, 1001, etc., that is, by $10^n + 1$.

*Method*: Place $n$ zeros to the right of the multiplicant and then add the multiplicant to the number so obtained.

**Illustration 4:** Multiply:

(a) $4782 \times 11$ (b) $9836 \times 101$

(c) $6538 \times 1001$

**Solution:** (a) $4782 \times 11 = 47820 + 4782 = 52602$

(b) $9836 \times 101 = 983600 + 9836 = 993436$

(c) $6538 \times 1001 = 6538000 + 6538 = 6544538$

3. Multiplication of a given number by 15, 25, 35, etc.

*Method*: Double the multiplier and then multiply the multiplicant by this new number and finally divide the product by 2.

**Illustrations 5:** Multiply:

(a) $7054 \times 15$ (b) $3897 \times 25$

(c) $4563 \times 35$

**Solution:** (a) $7054 \times 15 = \frac{1}{2}(7054 \times 30)$

$= \frac{1}{2}(211620) = 105810$

(b) $3897 \times 25 = \frac{1}{2}(3897 \times 50) = \frac{1}{2}(194850)$

$= 97425$

(c) $4536 \times 35 = \frac{1}{2}(4563 \times 70) = \frac{1}{2}(319410)$

$= 159705$

4. Multiplication of a given number by 5, 25, 125, 625, etc., that is, by a number which is some power of 5.

*Method*: Place as many zeros to the right of the multiplicant as is the power of 5 in the multiplier, then divide the number so obtained by 2 raised to the same power as is the power of 5.

**Illustration 6:** Multiply:

(a) $3982 \times 5$ (b) $4739 \times 25$

(c) $7894 \times 125$ (d) $4863 \times 625$

**Solution:** (a) $3982 \times 2 = \dfrac{39820}{2} = 19910$

(b) $4739 \times 25 = \dfrac{473900}{2^2} = \dfrac{473900}{4} = 118475$

(c) $7894 \times 125 = \dfrac{7894000}{2^3} = \dfrac{7894000}{8}$

$= 986750$

(d) $4863 \times 625 = \dfrac{48630000}{2^4} = \dfrac{48630000}{16}$

$= 3039375$

### Distributive Laws

For any three numbers $a$, $b$, $c$, we have

(a) $a \times b + a \times c = a \times (b + c)$

(b) $a \times b - a \times c = a \times (b - c)$

**Illustration 7:** $438 \times 637 + 438 \times 367 = ?$

**Solution:** $438 \times 637 + 438 \times 367 = 438 \times (637 + 367)$
$= 430 \times 1000$
$= 438000$

**Illustration 8:** $674 \times 832 - 674 \times 632 = ?$

**Solution:** $674 \times 832 - 674 \times 632$
$= 674 \times (832 - 632)$
$= 674 \times 200 = 134800$

## SQUARES (SHORT-CUT METHODS)

> 1. To square any number ending with 5.
> *Method*: $(A5)^2 = A(A + 1)/25$

**Illustration 9:**

(a) $(25)^2 = 2(2 + 1)/25 = 6/25 = 625$

(b) $(45)^2 = 4(4 + 1)/25 = 20/25 = 2025$

(c) $(85)^2 = 8(8 + 1)/25 = 72/25 = 7225$

> 2. To square a number in which every digit is one.
> *Method*: Count the number of digits in the given number and start writing numbers in ascending order from one to this number and then in descending order up to one.

**Illustration 10:**

(a) $11^2 = 121$

(b) $111^2 = 12321$

(c) $1111^2 = 1234321$

(d) $222^2 = 2^2(111)^2 = 4(12321) = 49284$

(e) $3333^2 = 3^2(1111)^2 = 9(1234321) = 11108889$

> 3. To square a number which is nearer to $10x$.
> *Method*: Use the formula:
> $x^2 = (x^2 - y^2) + y^2 = (x + y)(x - y) + y^2$

**Illustration 11:**

(a) $(97)^2 = (97 + 3)(97 - 3) + 3^2$
$= 9400 + 9 = 9409$

(b) $(102)^2 = (102 - 2)(102 + 2) + 2^2$
$= 10400 + 4 = 10404$

(c) $(994)^2 = (994 + 6)(994 - 6) + 6^2$
$= 988000 + 36 = 988036$

(d) $(1005)^2 = (1005 - 5)(1005 + 5) + 5^2$
$= 1010000 + 25 = 1010025$

### DIVISION

Division is repeated subtraction.

For example, when we divide 63289 by 43, it means 43 can be repeatedly subtracted 1471 times from 63289 and the remainder 36 is left.

$$\begin{array}{r l}
 & 1471 \leftarrow \text{Quotient} \\
\text{Divisor} \rightarrow 43) & 63289 \leftarrow \text{Dividend} \\
 & \underline{43\phantom{289}} \\
 & 202\phantom{89} \\
 & \underline{172\phantom{89}} \\
 & 308\phantom{9} \\
 & \underline{301\phantom{9}} \\
 & 79 \\
 & \underline{43} \\
 & \underline{36} \leftarrow \text{Remainder}
\end{array}$$

> Dividend = (Divisor × Quotient ) + Remainder
> or, Divisor = $\dfrac{\text{Dividend} - \text{Remainder}}{\text{Quotient}}$

**Illustration 12:** On dividing 7865321 by a certain number, the quotient is 33612 and the remainder is 113. Find the divisor.

**Solution:** Divisor $= \dfrac{\text{Dividend} - \text{Remainder}}{\text{Quotient}}$

$$= \frac{7865321 - 113}{33612} = \frac{7865208}{33612} = 234$$

**Illustration 13:** A number when divided by 315 leaves remainder 46 and the value of quotient is 7. Find the number.

**Solution:** Number = (Divisor × Quotient) + Remainder
$= (315 \times 7) + 46 = 2205 + 46 = 2251$

**Illustration 14:** Find the least number of 5 digits which is exactly divisible by 632.

**Solution:** The least number of 5 digits is 10000. Dividing this number by 632, the remainder is 520. So, the required number = 10000 + (632 + 520) = 10112.

$$\begin{array}{r l}
 & 15 \\
632) & 10000 \\
 & \underline{632\phantom{0}} \\
 & 3680 \\
 & \underline{3160} \\
 & \underline{520}
\end{array}$$

**Illustration 15:** Find the greatest number of 5 digits which is exactly divisible by 463.

**Solution:** The greatest number of 5 digits is 99999. Dividing this number by 463, the remainder is 454. So, the required number = 99999 – 454 = 99545.

$$\begin{array}{r} 215 \\ 463\overline{)\,99999} \\ \underline{926\phantom{00}} \\ 739\phantom{0} \\ \underline{463\phantom{0}} \\ 2769 \\ \underline{2315} \\ \underline{454} \end{array}$$

**Illustration 16:** Find the number nearest to 13700 which is exactly divisible by 235.

**Solution:** On dividing the number 13700 by 235, the remainder is 70. Therefore, the nearest number to 13700, which is exactly divisible by 235 = 13700 – 70 = 13630.

$$\begin{array}{r} 58 \\ 235\overline{)\,13700} \\ \underline{1175\phantom{0}} \\ 1950 \\ \underline{1880} \\ \underline{70} \end{array}$$

## TESTS OF DIVISIBILITY

1. **Divisibility by 2** A number is divisible by 2 if the unit's digit is zero or divisible by 2.
   For example, 4, 12, 30, 18, 102, etc., are all divisible by 2.
2. **Divisibility by 3** A number is divisible by 3 if the sum of digits in the number is divisible by 3.
   For example, the number 3792 is divisible by 3 since 3 + 7 + 9 + 2 = 21, which is divisible by 3.
3. **Divisibility by 4** A number is divisible by 4 if the number formed by the last two digits (ten's digit and unit's digit) is divisible by 4 or are both zero.
   For example, the number 2616 is divisible by 4 since 16 is divisible by 4.
4. **Divisibility by 5** A number is divisible by 5 if the unit's digit in the number is 0 or 5.
   For example, 13520, 7805, 640, 745, etc., are all divisible by 5.
5. **Divisibility by 6** A number is divisible by 6 if the number is even and sum of its digits is divisible by 3.
   For example, the number 4518 is divisible by 6 since it is even and sum of its digits 4 + 5 + 1 + 8 = 18 is divisible by 3.
6. **Divisibility by 7** The unit digit of the given number is doubled and then it is subtracted from the number obtained after omitting the unit digit. If the remainder is divisible by 7, then the given number is also divisible by 7.
   For example, consider the number 448. On doubling the unit digit 8 of 448 we get 16.
   Then, 44 – 16 = 28.
   Since 28 is divisible by 7, 448 is divisible by 7.
7. **Divisibility by 8** A number is divisible by 8, if the number formed by the last 3 digits is divisible by 8.
   For example, the number 41784 is divisible by 8 as the number formed by last three digits, i.e., 784 is divisible by 8.
8. **Divisibility by 9** A number is divisible by 9 if the sum of its digits is divisible by 9.
   For example, the number 19044 is divisible by 9 as the sum of its digits 1 + 9 + 0 + 4 + 4 = 18 is divisible by 9.
9. **Divisibility by 10** A number is divisible by 10, if it ends in zero.
   For example, the last digit of 580 is zero, therefore, 580 is divisible by 10.
10. **Divisibility by 11** A number is divisible by 11 if the difference of the sum of the digits at odd places and sum of the digits at even places is either zero or divisible by 11.
    For example, in the number 38797, the sum of the digits at odd places is 3 + 7 + 7 = 17 and the sum of the digits at even places is 8 + 9 = 17. The difference is 17 – 17 = 0, so the number is divisible by 11.
11. **Divisibility by 12** A number is divisible by 12 if it is divisible by 3 and 4.
12. **Divisibility by 18** An even number satisfying the divisibility test of 9 is divisible by 18.
13. **Divisibility by 25** A number is divisible by 25 if the number formed by the last two digits is divisible by 25 or the last two digits are zero.
    For example, the number 13675 is divisible by 25 as the number formed by the last two digits is 75 which is divisible by 25.
14. **Divisibility by 88** A number is divisible by 88 if it is divisible by 11 and 8.
15. **Divisibility by 125** A number is divisible by 125 if the number formed by the last three digits is divisible by 125 or the last three digits are zero.
    For example, the number 5250 is divisible by 125 as 250 is divisible by 125.

## SOME USEFUL SHORT-CUT METHODS

**1. Test to find whether a given number is a prime**

**Step 1** Select a least positive integer $n$ such that $n^2$ > given number.

**Step 2** Test the divisibility of given number by every prime number less than $n$.

**Step 3** The given number is prime only if it is not divisible by any of these primes.

**Illustration 17:** Investigate, whether 571 is a prime number

**Solution:** Since $(23)^2 = 529 < 571$ and $(24)^2 = 576 > 571$

$\therefore \quad n = 24$

Prime numbers less than 24 are 2, 3, 5, 7, 11, 13, 17, 19, 23. Since 24 is divisible by 2, 571 is not a prime number.

**Illustration 18:** Investigate whether 923 is a prime number.

**Solution:** Since $(30)^2 = 900 < 923$ and $(31)^2 = 961 > 923$

$\therefore \quad n = 31$

Prime numbers less than 31 are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29. Since 923 is not divisible by any of these primes, therefore, 923 is a prime number.

**2.** The least number, which when divided by $d_1$, $d_2$ and $d_3$ leaves the remainders $r_1$, $r_2$ and $r_3$ respectively such that $(d_1 - r_1) = (d_2 - r_2) = (d_3 - r_3)$, is = (L.C.M. of $d_1$, $d_2$ and $d_3$) – $(d_1 - r_1)$ or $(d_2 - r_2)$ or $(d_3 - r_3)$.

**Illustration 19:** Find the least number which when divided by 9, 10 and 15 leaves the remainders 4, 5 and 10, respectively.

**Solution:** Here, 9 – 4 = 10 – 5 = 15 – 10 = 5

Also, L.C.M. (9, 10, 15) = 90,

$\therefore$ the required least number = 90 – 5 = 85.

**3.** A number on being divided by $d_1$ and $d_2$ successively leaves the remainders $r_1$ and $r_2$, respectively. If the number is divided by $d_1 \times d_2$, then the remainder is = $(d_1 \times r_2 + r_1)$.

**Illustration 20:** A number on being divided by 10 and 11 successively leaves the remainders 5 and 7, respectively. Find the remainder when the same number is divided by 110.

**Solution:** The required remainder

$$= d_1 \times r_2 + r_1 = 10 \times 7 + 5 = 75.$$

**4.** To find the number of numbers divisible by a certain integer.

The method is best illustrated with the help of following example.

**Illustration 21:** How many numbers up to 532 are divisible by 15?

**Solution:** We divide 532 by 15

$$532 = \underline{35} \times 15 + 7$$

The quotient obtained is the required number of numbers. Thus, there are 35 such numbers.

**Illustration 22:** How many numbers up to 300 are divisible by 5 and 7 together?

**Solution:** L.C.M. of 5 and 7 = 35

We divide 300 by 35

$$300 = \underline{8} \times 35 + 20$$

Thus, there are 8 such numbers.

**5.** Two numbers when divided by a certain divisor give remainders $r_1$ and $r_2$. When their sum is divided by the same divisor, the remainder is $r_3$. The divisor is given by $r_1 + r_2 - r_3$.

**Illustration 23:** Two numbers when divided by a certain divisor give remainders 473 and 298, respectively. When their sum is divided by the same divisor, the remainder is 236. Find the divisor.

**Solution:** The required divisor

$$= 437 + 298 - 236 = 499.$$

## Exercise-1

1. $7372 \times 7372 + 7372 \times 628 = ?$
   (a) 58976000 (b) 58967000
   (c) 5897600 (d) None of these
2. $9999 + 8888 + 777 + ? = 19700$
   (a) 36 (b) 16
   (c) 64 (d) 26
3. $60 \ ? \ 6 \times 111 = 666666$
   (a) 0 (b) 2
   (c) 1 (d) 6
4. $3149 \times 1 \ ? \ 5 = 425115$
   (a) 3 (b) 2
   (c) 4 (d) 6
5. If the two digits of the age of Mr Manoj are reversed then the new age so obtained is the age of his wife. $\frac{1}{11}$ of the sum of their ages is equal to the difference between their ages. If Mr Manoj is older than his wife then find the difference between their ages.
   (a) Cannot be determined
   (b) 8 years
   (c) 10 years
   (d) 9 years
   (e) 7 years
6. If in a long division sum, the dividend is 380606 and the successive remainders from the first to the last are 434, 125 and 413, then divisor is:
   (a) 451 (b) 843
   (c) 4215 (d) 3372
7. If $\frac{x}{y} = \frac{3}{4}$, then the value of $\left(\frac{6}{7} + \frac{y-x}{y+x}\right)$ equals:
   (a) $\frac{5}{7}$ (b) $1\frac{1}{7}$
   (c) 1 (d) 2
8. The largest natural number by which the product of three consecutive even natural numbers is always divisible, is:
   (a) 16 (b) 24
   (c) 48 (d) 96
9. Which number should replace both the '*'s in $\left(\frac{*}{21}\right) \times \left(\frac{*}{189}\right) = 1$?
   (a) 21 (b) 63
   (c) 3969 (c) 147
10. In a division sum, the divisor is 12 times the quotient and 5 times the remainder. If the remainder be 48, then the dividend is:
    (a) 240 (b) 576
    (c) 4800 (d) 4848
11. What least number must be subtracted from 1294 so that the remainder when divided by 9, 11, 13 will leave in each case the same remainder 6?
    (a) 0 (b) 1
    (c) 2 (d) 3
12. 24 is divided into two parts such that 7 times the first part added to 5 times the second part makes 146. The first part is:
    (a) 11 (b) 13
    (c) 16 (d) 17
13. $\frac{1}{4}$ of a number subtracted from $\frac{1}{3}$ of the same number gives 12. The number is:
    (a) 144 (b) 120
    (c) 72 (d) 63
14. $\frac{4}{3}$ of a certain number is 64. Half of that number is:
    (a) 32 (b) 40
    (c) 80 (d) 16
15. A fraction becomes 4 when 1 is added to both the numerator and denominator; and it becomes 7 when 1 is subtracted from both the numerator and denominator. The numerator of the given fraction is:
    (a) 2 (b) 3
    (c) 7 (d) 15
16. Three numbers are in the ratio 3:4:5. The sum of the largest and the smallest equals the sum of the third and 52. The smallest number is:
    (a) 20 (b) 27
    (c) 39 (d) 52
17. The sum of three numbers is 68. If the ratio between first and second is 2:3 and that between second and third is 5:3, then the second number is:
    (a) 30 (b) 20
    (c) 58 (d) 48
18. If 1 is added to the denominator of a fraction, the fraction becomes $\frac{1}{2}$. If 1 is added to the numerator, the fraction becomes 1. The fraction is:

(a) $\frac{4}{7}$ (b) $\frac{5}{9}$
(c) $\frac{2}{3}$ (c) $\frac{10}{11}$

**19.** $\frac{4}{5}$ of a number exceeds its $\frac{2}{3}$ by 8. The number is:
(a) 30 (b) 60
(c) 90 (d) None of these

**20.** What is the sum of all prime numbers from 60 to 80?
(a) 361 (b) 341
(c) 351 (d) 349

**21.** The quotient arising from the division of 24446 by a certain divisor is 79 and the remainder is 35, what is the divisor?
(a) 39 (b) 309
(c) 390 (d) 3009

**22.** In a division sum, the quotient is 120, the divisor 456 and the remainder 333, find the dividend.
(a) 5533 (b) 50553
(c) 56053 (d) 55053

**23.** The quotient arising from a division of a number by 62 is 463 and the remainder is 60, what is the number?
(a) 28666 (b) 28766
(c) 28576 (d) 28676

**24.** A number when divided by 221 gives a remainder 43. What remainder will be obtained by dividing the same number by 17?
(a) 11 (b) 8
(c) 9 (d) 13

**25.** Which one of the following is the largest prime number of three digits?
(a) 997 (b) 999
(c) 991 (d) 993

**26.** When a certain number is multiplied by 7, the product consists entirely of fives; find the least value of such a number.
(a) 79365 (b) 78365
(c) 77365 (d) 79265

**27.** In a division sum, the divisor is 10 times the quotient and five times the remainder. What is the dividend, if the remainder is 46?
(a) 5636 (b) 5536
(c) 5336 (d) 5436

**28.** Which one of the following is the least number of four digits divisible by 71?
(a) 1006 (b) 1065
(c) 1094 (d) 1056

**29.** How many numbers up to 100 are divisible by 7?
(a) 14 (b) 107
(c) 93 (d) 100

**30.** How many numbers up to 500 are divisible by 23?
(a) 23 (b) 27
(c) 21 (d) 19

**31.** How many numbers up to 200 are divisible 2 and 3 both?
(a) 35 (b) 33
(c) 29 (d) 27

**32.** How many numbers between 100 and 300 are divisible by 11?
(a) 11 (b) 10
(c) 12 (d) 18

**33.** How many numbers between 150 and 500 are divisible by 2, 3 and 7 together?
(a) 9 (b) 8
(c) 10 (d) 11

**34.** The number of five figures to be added to a number of four fives to obtain the least number of six figures exactly divisible by 357 is:
(a) 94762 (b) 94802
(c) 94485 (d) None of these

**35.** The nearest figure to 58701 which is divisible by 567 is:
(a) 58968 (b) 58434
(c) 58401 (d) None of these

**36.** The digits indicated by * in 3422213 ** so that this number is divisible by 99 are:
(a) 1, 9 (b) 3, 7
(c) 4, 6 (d) 5, 5

**37.** The least value to be given to * so that the number 5 * 3457 is divisible by 11 is:
(a) 2 (b) 3
(c) 0 (d) 4

**38.** The nearest whole number to one million which is divisible by 537 is:
(a) 1000106 (b) 999894
(c) 1000437 (d) 999563

**39.** The smallest number between 400 and 500 which is divisible by 9 is:
(a) 414 (b) 405
(c) 423 (d) None of these

**40.** Which one of the following is the greatest number of five digits divisible by 231?

(a) 99792 (b) 99892
(c) 99692 (d) 99972

**41.** Find the number nearest to 16386 which is exactly divisible by 425.

(a) 16575 (b) 16375
(c) 16050 (d) 16450

**42.** Find the least number which must be subtracted from 9269 so that resulting number is exactly divisible by 73?

(a) 17 (b) 57
(c) 71 (d) 63

**43.** Find the least number which must be added to 15463 so that the resulting number is exactly divisible by 107?

(a) 52 (b) 71
(c) 55 (d) 19

**44.** What is the number just more than 5000 which is exactly divisible by 73?

(a) 5001 (b) 5009
(c) 5037 (d) 5027

**45.** The sum of two numbers is 100 and their difference is 37. The difference of their squares is:

(a) 37 (b) 100
(c) 63 (d) 3700

**46.** The number of times 79 be subtracted from 50000, so that the remainder be 43759; is:

(a) 69 (b) 79
(c) 59 (d) None of these

**47.** The ratio between two numbers is 3:4 and their sum is 420. The greater of the two numbers is:

(a) 175 (b) 200
(c) 240 (d) 315

**48.** The difference between the squares of two consecutive numbers is 35. The numbers are:

(a) 14, 15 (b) 15, 16
(c) 17, 18 (d) 18, 19

**49.** Three-fourths of one-fifth of a number is 60. The number is:

(a) 300 (b) 400
(c) 450 (d) 1200

**50.** The sum of squares of two numbers is 80 and the square of their difference is 36. The product of the two numbers is:

(a) 22 (b) 44
(c) 58 (d) 116

**51.** A number when divided by 357 gives a remainder 37. By dividing the same number by 17, the remainder would be:

(a) 3 (b) 4
(c) 2 (d) None of these

**52.** The product of two numbers is 120. The sum of their squares is 289. The sum of the two numbers is:

(a) 20 (b) 23
(c) 169 (d) None of these

**53.** Three numbers are in the ratio 4:5:6 and their average is 25. The largest number is:

(a) 42 (b) 36
(c) 30 (d) 32

**54.** A number exceeds 20% of itself by 40. The number is:

(a) 50 (b) 60
(c) 80 (d) 320

**55.** If 16% of 40% of a number is 8, the number is:

(a) 200 (b) 225
(c) 125 (d) 320

**56.** 4767 exactly divides *** 341, the missing digits are:

(a) 468 (b) 586
(c) 363 (d) None of these

**57.** A number when divided by a certain divisor left remainder 241, when twice the number was divided by the same divisor, the remainder was 112. Find the divisor.

(a) 370 (b) 365
(c) 380 (d) 456

**58.** Two numbers when divided by a certain divisor give remainders 43 and 37 respectively, when their sum is divided by the same divisor, the remainder is 13. Find the divisor.

(a) 71 (b) 67
(c) 57 (d) 77

**59.** Two numbers are such that the ratio between them is 3:5; but if each is increased by 10, the ratio between them becomes 5:7. The numbers are:

(a) 3, 5 (b) 7, 9
(c) 13, 22 (d) 15, 25

**60.** Divide 50 into two parts so that the sum of their reciprocals is 1/12.

(a) 20, 30 (b) 24, 26
(c) 28, 22 (d) 36, 14

**61.** The sum of seven numbers is 235. The average of the first three is 23 and that of last three is 42. The fourth number is:

(a) 40 (b) 126
(c) 69 (d) 195

**62.** The sum of squares of two numbers is 68 and the squares of their difference is 36. The product of the two numbers is:

(a) 16 (b) 32
(c) 58 (d) 104

**63.** What is the least value of $K$ so that the number $6735K1$ is divisible by 9?

(a) 5 (b) 7
(c) 4 (d) 3

**64.** For what value of $K$, the number $7236K2$ is divisible by 8?

(a) 7 (b) 5
(c) 4 (d) 9

**65.** Find the least values of $x$ and $y$ so that the number $5x423y$ is divisible by 88.

(a) 8, 2 (b) 7, 3
(c) 9, 4 (d) 6, 5

**66.** 24 is divided into two parts such that 7 times the first part added to 5 times the second part makes 146. The first part is:

(a) 13 (b) 15
(c) 17 (d) 19

**67.** Sum of three numbers is 132. First number is twice the second and third number is one-third of the first. Find the second number.

(a) 18 (b) 36
(c) 20 (d) 16

**68.** What least number must be added to 7231 so that the resulting number is exactly divisible by 5 and 9 together?

(a) 20 (b) 18
(c) 14 (d) 16

**69.** Find a number nearest to 9231 which is exactly divisible by 3 as well as by 11.

(a) 9240 (b) 9340
(c) 9540 (d) 9440

**70.** Find a nearest number to 12199 which is exactly divisible by the product of the first four prime numbers.

(a) 12181
(b) 12179
(c) 11281
(d) 11279

**71.** The sum of squares of two numbers is 90 and the squares of their difference is 46. The product of the two numbers is:

(a) 22 (b) 24
(c) 26 (d) 28

**72.** If 40% of a number is 360, what will be 15% of that number?

(a) $20\frac{1}{4}$ (b) $20\frac{1}{2}$

(c) $22\frac{1}{4}$ (d) $22\frac{1}{2}$

**73.** The sum of the digits of a two-digit number is 8. If the digits are reversed the number is increased by 54. Find the number.

(a) 17 (b) 19
(c) 21 (d) 23

## EXERCISE-2
## (BASED ON MEMORY)

**1.** The sum of the two digits of a two digit number is 12 and the difference between the two digits of the two digit number is 6. What is the two-digit number?

(a) 39 (b) 84
(c) 93 (d) Cannot be determined
(e) None of these

**[SBI PO, 2008]**

**2.** Which of the following smallest number should be added to 6659 to make it a perfect square?

(a) 230 (b) 65
(c) 98 (d) 54
(e) None of these

**[SBI PO, 2008]**

**3.** Two numbers are such that the sum of twice the first number and thrice the first number and thrice the second number is 36 and the sum of twice the second number is 39. Which is the smaller number?

(a) 9 (b) 5
(c) 7 (d) 3
(e) None of these

**[SBI PO, 2008]**

**4.** The difference between a two-digit number and the number obtained by interchanging the two digits of the numbers is 36. What is the difference between the two digits of the number?

(a) 6 (b) 4
(c) 3 (d) Cannot be determined
(e) None of these

**[NABARD PO, 2008]**

**5.** In a two digit number the digit in the unit's place is twice the digit in the ten's place and the number obtained by interchanging the digits is more than the original number by 27. What is 50 % of the original number?

(a) 36 (b) 63
(c) 48 (d) 18
(e) None of these

**[SBI PO, 2005]**

**6.** 64329 is divided by a certain number. While dividing, the numbers, 175, 114 and 213 appear as three successive remainders. The divisor is successive remainders. The divisor is:

(a) 184 (b) 224
(c) 234 (d) 296

**[SSC (GL) Prel. Examination, 2007]**

**7.** A 2-digit number is 3 times the sum of its digits. If 45 is added to the number, its digits are interchanged. The sum of the digits of the number is:

(a) 11 (b) 9
(c) 7 (d) 5
(e) None of these

**[SSC (GL) Prel. Examination, 2007]**

**8.** A number divided by 56 gives 29 as remainder. If the same number is divided by 8, the remainder will be:

(a) 7 (b) 6
(c) 5 (d) 4

**[SSC (GL) Prel. Examination, 2007]**

**9.** The total number of integers between 200 and 400, each of which either begins with 3 or ends with 3 or both, is:

(a) 10 (b) 100
(c) 110 (d) 120

**[SSC (GL) Prel. Examination, 2007]**

**10.** A 4-digit number is formed by repeating a 2-digit number such as 2525, 3232, etc. Any number of this form is always exactly divisible by:

(a) 7
(b) 11
(c) 13
(d) Smallest 3-digit prime number

**[SSC (GL) Prel. Examination, 2005]**

**11.** A number divided by 68 gives the quotient 269 and remainder zero. If the same number is diveded by 67, then the remainder is:

(a) 0 (b) 1
(c) 2 (d) 3

**[SSC (GL) Pref. Examination, 2005]**

**12.** How many numbers less than 1000 are multiples of both 10 and 13?

(a) 9 (b) 8
(c) 6 (d) 7

**[SSC (GL) Pref. Examination, 2005]**

**13.** If the sum and difference of two numbers are 20 and 8 respectively, then the difference of their squares is:

(a) 12 (b) 28
(c) 80 (d) 160

**[SSC (GL) Pref. Examination, 2005]**

**14.** The sum of the squares of two positive integer is 100 and the difference of their squares is 28. The sum of the numbers is:

(a) 12 (b) 13
(c) 14 (d) 15

**[SSC (GL) Pref. Examination, 2005]**

**15.** The smallest number added to 680621 to make the sum a perfect square is:

(a) 4 (b) 5
(c) 6 (d) 8

**[SSC (GL) Pref. Examination, 2005]**

**16.** What is the least number to be added to 920 to make it a perfect square?

(a) 41 (b) 31
(c) 39 (d) 49
(e) None of these

**[Bank of Maharashtra(Specialist Officer), 2006]**

**17.** If the digits of a two-digit number are interchanged, the number so obtained is greater than the original number by 27. If the sum of the two digits of the number is 11, what is the original number?

(a) 47 (b) 38
(c) 74 (d) Cannot be determined
(e) None of these

**[Central Bank of India PO, 2006]**

**18.** A two-digit even number has both the digits same and the number is divisible by 4. When divided by 4 the number obtained is an even number. What is the original number?

(a) 44 (b) 22
(c) 66 (d) Cannot be determined
(e) None of these

**[IOB PO, 2006]**

**19.** The sum of the digits of a two-digit number is 81 less than the number. What is the differrence between the digits of the number?

(a) 6 (b) 3
(c) 1 (d) Cannot be determined
(e) None of these

**[IOB PO, 2006]**

**20.** While solving a mathematical problem, Samidha squared a given number and then subtracted 25 from it rather than doing what was required, i.e., first substracting 25 from the number and then squaring it. But she got the right answer. What was the given number:

(a) 48 (b) 13
(c) 38 (d) Cannot be determined
(e) None of these

**[IOB PO, 2006]**

**21.** The difference between a two-digit number and the number obtained by interchanging the digits is 18. The sum of the digits is 10 and the digit at the ten's place is bigger than the digit at the unit's place, What is the two-digit number?

(a) 82 (b) 46
(c) 64 (d) 73
(e) None of these

**[PNB Management Trainee, 2007]**

**22.** When a number is divided by 31 the remainder is 29. When the same number is divided by 16, what will be the remainder?

(a) Data inadequate (b) 13
(c) 15 (d) 11
(e) None of these

**[IBP Jr. Executive Examination, 2002]**

**23.** If the digit in the units place of a two-digit number is halved and the digit in the tens place is doubled, the number thus obtained is equal to the number obtained by interchanging the digits. Which of the following is definitely true?

(a) Digits in the units place and the tens place are equal.
(b) Sum of the digits is a two-digit number.
(c) Digit is the units place is half of the digit in the tens place.
(d) Digit in the units place is twice the digit in the tens place.
(e) None of these

**[PNB Management Trainee Examination, 2003]**

**24.** Twenty times a positive integer is less than its square by 96. What is the integer?

(a) 24 (b) 20
(c) 30 (d) Cannot be determined
(e) None of these

**[Bank of Maharashtra PO Examination, 2003]**

**25.** The product of two consecutive even numbers is 9408. The greater number is:

(a) 94 (b) 102
(c) 104 (d) 98

**[IOB Clerk Examination, 2009]**

**26.** If $\frac{1}{8}$ of $\frac{2}{3}$ of $\frac{4}{5}$ of a number is 12, then 30 per cent of the number will be:

(a) 48 (b) 64
(c) 54 (d) 42

**[BSRB Chennai Bank PO, 2000]**

**27.** When any number is divided by 12 then, dividend becomes one-fourth of the other number. By how much per cent is first number greater than the second number?

(a) 200 (b) 150
(c) 300 (d) Data inadequate

**[BSRB Chennai Bank PO, 2000]**

**28.** The sum of the digits of a two digit number is of the difference between the number and the number obtained by interchanging the positions of the digits. What definitely is the difference between the digits of that number?

(a) 5 (b) 9
(c) 7 (d) Data inadequate

**[BSRB Chennai Bank PO, 2000]**

**29.** A number gets reduced to its $\frac{1}{3}$ when 48 is subtracted from it. What is $\frac{2}{3}$ of that number?

(a) 24 (b) 72
(c) 36 (d) 48

**[BSRB Bhopal Bank PO, 2000]**

**30.** The sum of three consecutive numbers is given, what is the difference between first and third number?

(a) 1 (b) 3
(c) Either 1 or 2 (d) 2

**[BSRB Bhopal Bank PO, 2000]**

**31.** If the two digits of the age of Mr Manoj are reversed then, the new age so obtained is the age of his wife.

$\frac{1}{11}$ of the sum of their ages is equal to the difference between their ages. If Mr Manoj is elder than his wife then find the difference between their ages?

(a) Cannot be determined
(b) 10 years
(c) 8 years
(d) 7 years
(e) 9 years

**[BSRB Bangalore Bank PO, 2000]**

**32.** A number is decreased by 4 and divided by 6, the result is 9. What would be the result if 3 is subtracted from the number and then it is divided by 5?

(a) $9\frac{2}{5}$ (b) $10\frac{1}{5}$
(c) $11\frac{2}{5}$ (d) 11

**[BSRB Delhi Bank PO, 2000]**

**33.** A two digits number is seven times the sum of its digits. If each digit is increased by 2, the number thus obtained is 4 more than six times the sum of its digits. Find the number.

(a) 42 (b) 24
(c) 48 (d) Data inadequate

**[BSRB Patna Bank PO, 2001]**

**34.** If $A$ and $B$ are positive integers such that $9A^2 = 12A + 96$ and $B^2 = 2B + 3$, then which of the following is the value of $5A + 7B$?

(a) 31 (b) 41
(c) 36 (d) 43

**[BSRB Patna Bank PO, 2001]**

**35.** The digit in the units place of a number is equal to the digit in the tens place of half of that number and the digit in the tens place of that number is less than the digit in units place of half of the number by 1. If the sum of the digits of the number is seven, then what is the number?

(a) 52 (b) 16
(c) 34 (d) Data inadequate

**[SBI Bank PO, 2001]**

**36.** Two fifths of one-third of three-sevenths of a number is 15. What is 40 per cent of that number?

(a) 136 (b) 140
(c) 72 (d) None of these

**[IBPS Jr. Executive Examination, 2002]**

**37.** If 3167 is added to 4093 and the sum is divided by 145, approximately what will be the outcome?

(a) 50 (b) 75
(c) 60 (d) 90
(e) 80

**[IBPS Jr. Executive Examination, 2002]**

**38.** When a number is divided by 31 the remainder is 29. When the same number is divided by 16, what will be the remainder?

(a) Data inadequate (b) 13
(c) 15 (d) 11

**[IBP Jr. Executive Examination, 2002]**

**39.** Twenty times a positive integer is less than its square by 96. What is the integer?

(a) 24 (b) 20
(c) 30 (d) Cannot be determined

**[Bank of Maharashtra PO Examination, 2003]**

**40.** The sum of the squares of two consecutive even numbers is 6500. Which is the smaller number?

(a) 54 (b) 52
(c) 48 (d) 56

**[Punjab National Bank PO, 2010]**

**41.** The sum of five consecutive even numbers of set-A is 220. What is the sum of a different set of five consecutive numbers whose second lowest number in 37 less than double of the lowest number of set-A?

(a) 223 (b) 225
(c) 235 (d) None of these

**[CBI PO, 2010]**

**42.** The product of two consecutive even numbers is 9408. Which is the greater of the two numbers?

(a) 96 (b) 98
(c) 94 (d) 92

**[Andhra Bank PO, 2008]**

**43.** The product of two successive even numbers is 6888. Which is the greater of the two numbers?

(a) 78 (b) 82
(c) 86 (d) None of these

**[Uttrakhand GBO PO, 2007]**

**44.** The number obtained by interchanging the digits of a two-digit number is less than the original number

by 63. If the sum of the digits of the number is 11, what is the original number?

(a) 29 (b) 92
(c) 74 (d) Cannot be determined

**[SBI PO, 2008]**

**45.** A number is of two digits. The position of digits is interchanged and the new number is added to the original number. The resultant number will always be divisible by:

(a) 8 (b) 9
(c) 10 (d) 11

**[UPPCS, 2012]**

**46.** When $2^{23}$ is divided by 10, the remainder will be:

(a) 2 (b) 3
(c) 4 (d) 8

**[SSC (GL), 2011]**

**47.** Find the unit digit in the product $(4387)^{245} \times (621)^{72}$.

(a) 1 (b) 2
(c) 5 (d) 7

**[SSC (GL), 2011]**

**48.** If $a$ and $b$ are odd numbers, then which of the following is even?

(a) $a + b + ab$ (b) $a + b - 1$
(c) $a + b + 1$ (d) $a + b + 2ab$

**[SSC (GL), 2011]**

**49.** $2^{16} - 1$ is divisible by:

(a) 11 (b) 13
(c) 17 (d) 19

**[SSC (GL), 2011]**

**50.** The sum of two numbers is 24 and their product is 143. The sum of their squares is:

(a) 296 (b) 295
(c) 290 (d) 228

**[SSC (GL), 2011]**

**51.** The unit digit in the sum $(124)^{372} + (124)^{373}$ is:

(a) 5 (b) 4
(c) 2 (d) 0

**[SSC (GL), 2011]**

**52.** If the sum of two numbers be multiplied by each number separately, the products so obtained are 247 and 114. The sum of the numbers is:

(a) 19 (b) 20
(c) 21 (d) 23

**[SSC (GL), 2011]**

**53.** Find a number, one-seventh of which exceeds its eleventh part by 100.

(a) 1925 (b) 1825
(c) 1540 (d) 1340

**[SSC (GL), 2011]**

**54.** $\sqrt{6+\sqrt{6+\sqrt{6+\cdots=?}}}$

(a) 2.3 (b) 3
(c) 6 (d) 6.3

**[SSC (GL), 2011]**

**55.** When 335 is added to $5A7$, the result is $8B2$. $8B2$ is divisible by 3. What is the largest possible value of $A$?

(a) 8 (b) 2
(c) 1 (d) 4

**[SSC, 2013]**

**56.** Which one of the following numbers is divisible by 25?

(a) 303310 (b) 373355
(c) 303375 (d) 22040

**[SSC, 2013]**

**57.** The units digit in $3 \times 38 \times 537 \times 1256$ is:

(a) 4 (b) 2
(c) 6 (d) 8

**[SSC, 2013]**

**58.** The last digit, that is, the digit in the unit's place of the number $[(57)^{25} - 1]$ is:

(a) 6 (b) 8
(c) 0 (d) 5

**[SSC Assistant Grade III, 2012]**

**59.** A number $N$ is a positive three-digit number. If $x$ is in its hundred's place and $y$ is in itsunit's place, then the number $N - 100x - y$ is always divisible by:

(a) 8 (b) 9
(c) 10 (d) 11

**[SSC Assistant Grade III, 2012]**

**60.** $n$ is a whole number which when divided by 4 gives the remainder 3. The remainder when $2n$ is divided by 4 is:

(a) 1 (b) 2
(c) 3 (d) 0

**[SSC, 2012]**

**61.** If $m$and $n$ are positive integers and $(m - n)$ is an even number, then $(m^2 - n^2)$ will be always divisible by:

(a) 4 (b) 6
(c) 8 (d) 12

**[SSC, 2012]**

**62.** In a division sum, the divisor is 4 times the quotient and twice the remainder. If $a$ and $b$ are respectively the divisor and the dividend, then:

(a) $\frac{4b-a^2}{a} = 3$ (b) $\frac{4b-2a}{a^2} = 2$

(c) $(a + 1)^2 = 4b$ (d) $\frac{a(a+2)}{b} = 4$

**[SSC, 2011]**

**63.** If $738A6A$ is divisible by 11, then the value of $A$ is:

(a) 6 (b) 3
(c) 9 (d) 1

**[SSC, 2011]**

**64.** The product of two numbers is 1575 and their quotient is $\frac{9}{7}$. Then the sum of the numbers is:

(a) 74 (b) 78
(c) 80 (d) 90

**[SSC, 2011]**

**65.** When $(67^{67} + 67)$ is divided by 68, the remainder is:

(a) 1 (b) 63
(c) 66 (d) 67

**[SSC, 2011]**

**66.** The least positive integer that should be subtracted from $3011 \times 3012$ so that the difference is a perfect square, is:

(a) 3009 (b) 3010
(c) 3011 (d) 3012

**[SSC, 2011]**

**67.** A number, when divided by 296, gives 75 as the remainder. If the same number is divided by 37 then the remainder will be:

(a) 1 (b) 2
(c) 19 (d) 31

**[SSC, 2010]**

**68.** The sum and product of two numbers are 12 and 35 respectively. The sum of their reciprocals will be:

(a) $\frac{1}{3}$ (b) $\frac{1}{5}$

(c) $\frac{12}{35}$ (d) $\frac{35}{12}$

**[SSC, 2010]**

**69.** The greatest number among $\sqrt{5}, \sqrt[3]{4}, \sqrt[5]{2}, \sqrt[7]{3}$ is:

(a) $\sqrt[3]{4}$ (b) $\sqrt[7]{3}$

(c) $\sqrt{5}$ (d) $\sqrt[5]{2}$

**[SSC, 2010]**

**70.** Two numbers are such that their difference, their sum and their product are in the ratio of 1:7:24. The product of the numbers is:

(a) 24 (b) 36
(c) 48 (d) 60

**[SSC, 2010]**

**71.** Rachita enters a shop to buy ice-creams, cookies and pastries. She has to buy at least 9 units of each. She buys more cookies than ice-creams and more pastries than cookies. She picks up a total of 32 items. How many cookies does she buy?

(a) Either 12 or 13 (b) Either 11 or 12
(c) Either 10 or 11 (d) Either 9 or 11
(e) Either 9 or 10

**[IBPS PO/MT, 2012]**

**72.** The product of three consecutive even number is 4032. The product of the first and the third number is 252. What is five times the second number?

(a) 80 (b) 100
(c) 60 (d) 70
(e) 90

**[IBPS PO/MT, 2012]**

**73.** The sum of nine consecutive odd numbers of Set A is 621. What is the sum of a different set of six consecutive even numbers whose lowest number is 15 more than the lowest number of Set A?

(a) 498 (b) 468
(c) 478 (d) 488
(e) None of these

**[IOB PO, 2011]**

**74.** The sum of five consecutive even numbers of set A is 220. What is the sum of a different set of five consecutive numbers whose second lowest number is 37 less than double of the lowest number of set A?

(a) 223 (b) 225
(c) 235 (d) 243
(e) None of these

**[Central Bank of India PO, 2010]**

**75.** There are two numbers such that the sum of twice the first number and thrice the second number is 100 and the sum of thrice the first number and twice the second number is 120. Which is the larger number?

(a) 32 (b) 12
(c) 14 (d) 35
(e) None of these

**[Corporation Bank PO, 2010]**

**76.** The number obtained by interchanging the two digits of a two-digit number is lesser than the original number by 54. If the sum of the two digits of the number is 12, then what is the original number?

(a) 28 (b) 39
(c) 82 (d) Cannot be determined
(e) None of these

**[IDBI Bank PO, 2009]**

**77.** The difference between a two-digit number and the number obtained by interchanging the two digits of the number is 9. If the sum of the two digits of the number is 15, then what is the original number?

(a) 89 (b) 67
(c) 87 (d) Cannot be determined
(e) None of these

**[OBC PO, 2009]**

**78.** The difference between a two-digit-number and the number obtained by interchanging the two digits of the number is 9. What is the difference between the two digits of the number?

(a) 3 (b) 2
(c) 1 (d) Cannot be determined
(e) None of these

**[NABARD Bank Officer, 2009]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (a) | **3.** (a) | **4.** (a) | **5.** (d) | **6.** (b) | **7.** (c) | **8.** (c) | **9.** (b) | **10.** (d) | **11.** (b) | **12.** (b) | **13.** (a) |
| **14.** (b) | **15.** (d) | **16.** (c) | **17.** (a) | **18.** (c) | **19.** (b) | **20.** (c) | **21.** (b) | **22.** (d) | **23.** (b) | **24.** (c) | **25.** (a) | **26.** (a) |
| **27.** (c) | **28.** (b) | **29.** (a) | **30.** (c) | **31.** (b) | **32.** (d) | **33.** (a) | **34.** (a) | **35.** (a) | **36.** (a) | **37.** (a) | **38.** (b) | **39.** (b) |
| **40.** (a) | **41.** (d) | **42.** (c) | **43.** (a) | **44.** (c) | **45.** (d) | **46.** (b) | **47.** (c) | **48.** (c) | **49.** (b) | **50.** (a) | **51.** (a) | **52.** (b) |
| **53.** (c) | **54.** (a) | **55.** (c) | **56.** (b) | **57.** (a) | **58.** (b) | **59.** (d) | **60.** (a) | **61.** (a) | **62.** (a) | **63.** (a) | **64.** (a) | **65.** (a) |
| **66.** (a) | **67.** (b) | **68.** (c) | **69.** (a) | **70.** (a) | **71.** (a) | **72.** (a) | **73.** (a) | | | | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (e) | **2.** (b) | **3.** (e) | **4.** (b) | **5.** (d) | **6.** (c) | **7.** (b) | **8.** (c) | **9.** (c) | **10.** (d) | **11.** (b) | **12.** (d) | **13.** (d) |
| **14.** (c) | **15.** (a) | **16.** (a) | **17.** (a) | **18.** (e) | **19.** (d) | **20.** (b) | **21.** (c) | **22.** (a) | **23.** (d) | **24.** (a) | **25.** (d) | **26.** (*c*) |
| **27.** (d) | **28.** (a) | **29.** (d) | **30.** (d) | **31.** (e) | **32.** (d) | **33.** (a) | **34.** (b) | **35.** (a) | **36.** (d) | **37.** (a) | **38.** (a) | **39.** (a) |
| **40.** (d) | **41.** (d) | **42.** (b) | **43.** (d) | **44.** (b) | **45.** (d) | **46.** (a) | **47.** (d) | **48.** (d) | **49.** (c) | **50.** (c) | **51.** (d) | **52.** (a) |
| **53.** (a) | **54.** (b) | **55.** (d) | **56.** (c) | **57.** (d) | **58.** (a) | **59.** (c) | **60.** (b) | **61.** (a) | **62.** (d) | **63.** (c) | **64.** (c) | **65.** (c) |
| **66.** (c) | **67.** (a) | **68.** (c) | **69.** (c) | **70.** (c) | **71.** (c) | **72.** (a) | **73.** (e) | **74.** (e) | **75.** (a) | **76.** (e) | **77.** (d) | **78.** (c) |

## EXPLANATORY ANSWERS

### EXERCISE-1

**1. (a)** Given Expression $= 7372 \times (7372 + 628)$
$= 7372 \times 8000$
$= 58976000.$

**2. (a)** Let, $9999 + 8888 + 777 + x = 19700$
$\therefore \quad x = 19700 - 19664 = 36.$

**3. (a)** Let, $x \times 111 = 666666$
$\Rightarrow \quad x = \dfrac{666666}{111} = 6006 \qquad \therefore$ Missing figure = 0.

**4. (a)** Let, $3149 \times x = 425115$
$\Rightarrow \quad x = \dfrac{425115}{3149} = 135 \qquad \therefore$ Missing digit = 3.

**5. (d)** Let the age of Mr Manoj be $(10x + y)$ years.
$\therefore$ His wife's age $= (10y + x)$ years
Then, $(10x + y + 10y + x)\dfrac{1}{11} = 10x + y - 10y - x$
or, $x + y = 9x - 9y$, or, $8x = 10y$
or, $\dfrac{x}{y} = \dfrac{5}{4}$
$\therefore \quad x = 5$ and $y = 4$
[$\because$ any other multiple of 5 will make $x$ of two digits]
$\therefore$ Difference $= 10x + y - 10y - x$
$= 9x - 9y = 9(x - y)$
$= 9(5 - 4) = 9$ years.

**9. (b)** Let, $\dfrac{x}{21} \times \dfrac{x}{189} = 1.$
Then, $x^2 = 21 \times 189 = 21 \times 21 \times 3 \times 3$
$\therefore \quad x = 21 \times 3 = 63.$

**10. (d)** Let Quotient $= Q$ and remainder $= R$
Then, given $12Q = 5R$
Now, $R = 48 \Rightarrow 12Q = 5 \times 48 \Rightarrow Q = 20$
$\therefore$ Dividend $= 20 \times 240 + 48 = 4848.$

**11. (b)** The number when divided by 9, 11 and 13 leaving remainder 6 = (L.C.M. of 9, 11, 13) + 6 = 1293
$\therefore$ Required number $= 1294 - 1293 = 1.$

**12. (b)** Let these parts be $x$ and $(24 - x)$.
Then, $7x + 5\,(24 - x) = 146 \Rightarrow x = 13$
So the first part is 13.

**13. (a)** $\dfrac{1}{3}x - \dfrac{1}{4}x = 12 \Rightarrow \dfrac{1}{12}x = 12 \Rightarrow x = 144.$

**14. (b)** $\dfrac{4}{5} \times x = 64 \Rightarrow x = \dfrac{64 \times 5}{4} = 80$
$\therefore \quad \dfrac{1}{2} \times x = \dfrac{1}{2} \times 80 = 40.$

**15. (d)** Let the required fraction be $\dfrac{x}{y}$
Then, $\dfrac{x+1}{y+1} = 4 \Rightarrow x - 4y = 3$
and, $\dfrac{x-1}{y-1} = 7 \Rightarrow x - 7y = -6$
Solving these equations, we get $x = 15$, $y = 3$.

**16. (c)** Let the numbers be $3x$, $4x$ and $5x$.
Then, $5x + 3x = 4x + 52 \Rightarrow 4x = 52 \Rightarrow x = 13$
$\therefore$ The smallest number $= 3x = 3 \times 13 = 39.$

**17. (a)** Let the numbers be $a$, $b$, $c$.
Then, $\dfrac{a}{b} = \dfrac{2}{3}, \dfrac{b}{c} = \dfrac{5}{3} \Rightarrow \dfrac{a}{b} = \dfrac{2 \times 5}{3 \times 5} = \dfrac{10}{15}, \dfrac{b}{c} = \dfrac{5 \times 3}{3 \times 3} = \dfrac{15}{9}$
$\Rightarrow \quad a{:}b{:}c = 10{:}15{:}9$
Let the numbers be $10x$, $15x$, $9x$,
Then, $10x + 15x + 9x = 68 \Rightarrow 34x = 68 \Rightarrow x = 2$
$\therefore$ Second number $= 15x = 15 \times 2 = 30.$

**18. (c)** Let the required fraction be $\dfrac{x}{y}$.
Then, $\dfrac{x}{y+1} = \dfrac{1}{2} \Rightarrow 2x - y = 1$
and, $\dfrac{x+1}{y} = 1 \Rightarrow x - y = -1$
Solving, $2x - y = 1$ and $x - y = -1$,
we get, $x = 2$, $y = 3$
$\therefore$ The fraction is $\dfrac{2}{3}$.

**19. (b)** Let the number be $x$.
Then, $\dfrac{4}{5}x - \dfrac{2}{3}x = 8 \Rightarrow \dfrac{12x - 10x}{15} = 8 \Rightarrow 2x = 120$
or, $x = 60.$

**20. (c)** $61 + 67 + 71 + 73 + 79 = 351.$

**21. (b)** Divisor $= (24446 - 35) \div 79 = 309.$

**22. (d)** Dividend $= 456 \times 120 + 33 = 55053.$

**23. (b)** Number $= 463 \times 62 + 60 = 28766.$

**24. (c)** Dividing 43 by 17, the remainder is 9.

**26. (a)**
$$\begin{array}{r|l} 7 & 555555 \\ \hline & 79365 \end{array}$$
$\therefore$ The least number is 79365.

**27. (c)** Remainder = 46
Divisor $= 5 \times 46 = 230$
Also, $10 \times$ quotient $= 5 \times$ remainder
$\therefore$ Remainder $= 2 \times$ quotient
That is, quotient = 23
Dividend $= 23 \times 230 + 46 = 5336.$

28. **(b)**
$$\begin{array}{r|l} 71 & 1000\ (14 \\ & -71 \\ & \overline{\ \ 290} \\ & -284 \\ & \overline{\ \ \ \ 6} \end{array}$$

$\therefore$ Least number $= 1000 - 6 + 71 = 1065$.

29. **(a)** Quotient when 100 is divided by 7 is 14.

30. **(c)** Quotient when 500 is divided by 23 is 21.

31. **(b)** Quotient when 200 is divided by the L.C.M. of 2 and 3, i.e., 6 is 33.

32. **(d)** Quotient when 300 and 100 are divided by 11 are 27 and 9.
$\therefore$ Between 300 and 100, there are $27 - 9$, i.e., 18 numbers.

33. **(a)** A number divisible by 2, 3, and 7 is divisible by their L.C.M., i.e., 42. Up to 100, there are 2 numbers divisible by 42. Up to 500, there are 11 numbers divisible by 42.
$\therefore$ Between 100 and 500, there are $11 - 2$, i.e., 9 numbers divisible by 42.

34. **(a)** The least number of six figures is 100000
On dividing 100000 by 357, remainder = 40
$\therefore$ Least number of six figures which is divisible by 357
$= 100000 + (357 - 40) = 100317$
$\therefore$ Required number $= 100317 - 5555 = 94762$.

35. **(a)** On dividing 58701 by 567,
Remainder $= 300 > \frac{1}{2}\ (567)$
$\therefore$ Integer nearest to 58701 and divisible by 567
$= 58701 + (567 - 300)$
$= 58701 + 267 = 58968$.

36. **(a)** Let $x$, $y$ be the required digits.
The number is to be divisible by 99, i.e., 9 and 11 both.
$\therefore$ Sum of digits is to be divisible by 9, i.e.,
$3 + 4 + 2 + 2 + 2 + 1 + 3 + x + y = 17 + x + y$
is to be divisible by 9 and,
$(y + 3 + 2 + 2 + 3) - (x + 1 + 2 + 4) = 0$
or, multiple of 11, i.e., $y - x + 3 = 0$ or multiple of 11
$\therefore$ $x = 1$, $y = 9$.

37. **(a)** Let the least value to be given to * be $x$
Then, $x + 4 + 7 = 5 + 3 + 5$
$x = 2$.

38. **(b)** On dividing 100000 by 537, remainder
$$= 106 < \frac{537}{2}$$
$\therefore$ Nearest whole number to one million which is divisible by $537 = 100000 - 106 = 999894$.

39. **(b)** On dividing 400 by 9, remainder = 4
$\therefore$ Number nearest to 400 and divisible by 9
$= 400 + (9 - 4) = 405$.

40. **(a)** Greatest number of five digits = 99,999
Dividing this by 231, the remainder = 207
$\therefore$ Required greatest number
$= 99999 - 207 = 99792$.

41. **(d)** Dividing 16386 by 425, the remainder is 361 which is more than half the divisor, therefore, the required number is $16368 + (425 - 361) = 16450$.

42. **(c)** Divide 9269 by 73, the remainder is 71.
$\therefore$ 71 is the required least number.

43. **(a)** Divide 15463 by 107, the remainder is 55, therefore, the number to be added $= 107 - 55 = 52$.

44. **(c)** Dividing 5000 by 73, the remainder is 36. The number greater than 5000 is obtained by adding to 5000 the difference of divisor and the remainder.
$\therefore$ The required number $= 5000 + (73 - 36) = 5037$.

45. **(d)** Let the numbers be $a$ and $b$.
Then, $a + b = 100$ and $a - b = 37$
$\therefore$ $a^2 - b^2 = (a + b)(a - b) = 100 \times 37 = 3700$.

46. **(b)** $50000 = 79 \times \text{quotient} + 43759$
$\therefore$ $50000 - 43759 = 79 \times \text{quotient}$
or, $6241 = 79 \times \text{quotient}$
$\therefore$ Required number of times $= \frac{6241}{79} = 79$.

47. **(c)** Let the numbers be $3x$ and $4x$.
Then, $3x + 4x = 420 \Rightarrow 7x = 420 \Rightarrow x = 60$
$\therefore$ Greater number $= 4 \times 60 = 240$.

48. **(c)** Let the numbers be $x$ and $(x + 1)$.
Then, $(x + 1)^2 - x^2 = 35 \Rightarrow x^2 + 2x + 1 - x^2 = 35$
$\Rightarrow 2x = 34$
or, $x = 17$
So, the numbers are 17 and 18.

49. **(b)** Let the number be $x$.
Then, $\frac{3}{4} \times \frac{1}{5} \times x = 60 \Rightarrow 3x = 60 \times 5 \times 4$
or, $x = 400$.

50. **(a)** Let the numbers be $a$ and $b$.
Then, $a^2 + b^2 = 80$ and $(a - b)^2 = 36$
$(a - b)^2 = 36 \Rightarrow a^2 + b^2 - 2ab = 36$
$\Rightarrow 2ab = (a^2 + b^2) - 36 = 80 - 36 = 44$
$\Rightarrow ab = 22$.

51. **(a)** Let $K$ be the quotient.
Then, number $= 357 \times K + 37$
$= 17 \times 21K + 17 \times 2 + 3$
$= 17 \times (21K + 2) + 3$
So, required remainder = 3 and new quotient $= 21K + 2$.

52. **(b)** Let the numbers be $a$ and $b$.
Then, $(a + b)^2 = (a^2 + b^2) + 2ab$
$= 289 + 2 \times 120 = 289 + 240 = 529$
$\therefore$ $a + b = \sqrt{529} \Rightarrow a + b = 23$.

**53.** **(c)** Let the numbers be $4x$, $5x$ and $6x$.

Then, $\frac{4x+5x+6x}{3} = 25$ or, $15x = 75 \Rightarrow x = 5$

$\therefore$ The largest number $= 6x = 6 \times 5 = 30$.

**54.** **(a)** Let the required number be $x$.

Then, $x - \frac{20}{100}x = 40$ or, $5x - x = 200$ or, $x = 50$.

**55.** **(c)** Let, $\frac{16}{100} \times \frac{40}{100} \times x = 8$

Then, $x = \frac{8 \times 100 \times 100}{16 \times 40} = 125$.

**56.** **(b)** Last digit of dividend = 1

Last digit of divisor = 7

$\therefore$ Last digit of quotient should be 3

$4767 \times 3 = 14301$

$4767 \times 20 = 95340$

$4767 \times 100 = 476700$

$\therefore$ $4767 \times (3 + 20 + 100) = 586341$

Missing digits are 586.

**57.** **(a)** The divisor $= r_1 + r_2 - r_3$

$= 241 + 241 - 112 = 370$.

**58.** **(b)** The divisor $= r_1 + r_2 - r_3 = 43 + 37 - 13 = 67$.

**59.** **(d)** Let the numbers be $3x$ and $5x$.

Then, $\frac{3x+10}{5x+10} = \frac{5}{7} \Rightarrow 7(3x + 10) = 5(5x + 10)$

$\Rightarrow x = 5$

$\therefore$ The numbers are 15 and 25.

**60.** **(a)** Let the numbers be $x$ and $(50 - x)$.

Then, $\frac{1}{x} + \frac{1}{50-x} = \frac{1}{12} \Rightarrow \frac{50-x+x}{x(50-x)} = \frac{1}{12}$

$\Rightarrow x^2 - 50x + 600 = 0$

$\Rightarrow x = 30$ or $20$.

$\therefore$ The numbers are 20, 30.

**61.** **(a)** $23 \times 3 + x + 42 \times 3 = 235 \Rightarrow x = 40$

$\therefore$ Fourth number = 40.

**62.** **(a)** Let the numbers be $a$ and $b$.

Then, $a^2 + b^2 = 68$ and $(a - b)^2 = 36$

Now, $(a - b)^2 = 36 \Rightarrow a^2 + b^2 - 2ab = 36$

$\Rightarrow 68 - 2ab = 36$

$\Rightarrow 2ab = 32 \Rightarrow ab = 16$.

**63.** **(a)** $6 + 7 + 3 + 5 + K + 1 = 22 + K$

The least number greater than 22 and divisible by 9 is 27

$\therefore$ $27 = 22 + K \Rightarrow K = 5$.

**64.** **(a)** The last three digits $6K2$ is divisible by 8 if $K$ is 3 or 7 since 632 and 672 are divisible by 8.

**65.** **(a)** Test of 8 is independent of the value of $x$. First, apply the test of 8. Last three digit of the given number are $23y$ which is divisible by 8 if $y$ is 2. Substitute for $y$.

The number now becomes $5x4232$.

Apply the test of 11.

Sum of the digits at odd and even places is

$5 + 4 + 3$, i.e., 12 and $x + 2 + 2$, i.e., $x + 4$

$\therefore$ $x + 4 = 12 \Rightarrow x = 8$

Hence, $x = 8$ and $y = 2$.

**66.** **(a)** Let $x$ be the first part so that the other part is $24 - x$.

$\therefore$ $7x + 5(24 - x) = 146 \Rightarrow x = 13$.

**67.** **(b)** Let the second number be $3x$, so that the first number is $6x$ and the third one is $2x$.

$\therefore$ $6x + 3x + 2x = 132$

$\Rightarrow 11x = 132$ or $x = 12$.

Second number $= 3x = 3 \times 12 = 36$.

**68.** **(c)** Divide 7231 by 45, the remainder is 31.

$\therefore$ Required number $= 45 - 31 = 14$.

**69.** **(a)** A number which is divisible by 3 and 11 is also divisible by 33. Dividing 9331 by 33, the remainder is 24 which is more than half the divisor.

```
33)9331(279
   66
   ---
   263
   231
   ---
    321
    297
    ---
     24
```

Since the remainder 24 is more than half the divisor 33,

$\therefore$ The nearest number $= 9231 + (33 - 24) = 9240$.

**70.** **(a)** Product of first four prime numbers is

$2 \times 3 \times 5 \times 7 = 210$

Dividing 12199 by 210, we find the remainder 19, which is less than half the divisor.

```
210)12199(58
    1050
    ----
     1699
     1680
     ----
       19
```

$\therefore$ The number nearer to 12199 divisible by 210 is $12199 - 18 = 12181$.

**71.** **(a)** Let the numbers be $x$ and $y$.

According to the question:

$x^2 + y^2 = 90$ ...(1)

and, $(x - y)^2 = 46$ ...(2)

From equation (2),

$(x - y)^2 = 46$ or, $x^2 + y^2 - 2xy = 46$

or, $90 - 2xy = 46$ or, $xy = \frac{90-46}{2} = 22$

$\therefore$ Product of two numbers = 22.

**72.** **(a)** Let the number be $x$.

Then, we have, 40% of $x = 360$

$\therefore$ $x = \frac{360 \times 100}{40} = 900$

Now, 15% of $x = \frac{15}{100} \times 900 = 135$

Again, 15% of $135 = \frac{15}{100} \times 135 = 20.25$.

**73.** **(a)** Let the two digit number be $10x + y$

Then, we have, $x + y = 8$ ...(1)

and, $10y + x = 10x + y + 54$

or, $y - x = 6$ ...(2)

From equations (1) and (2),

the required number $= 1 \times 10 + 7 = 17$.

## Exercise-2
## (Based on Memory)

**1.** **(e)** Let the number be $10x + y$

$x + y = 12$

and, $x - y = 6$

$\therefore x = 9$

and, $y = 3$

or, $x = 3$

and, $y = 9$

$\therefore$ Hence the number may be 93 or 39.

**2.** **(b)**

$$\begin{array}{r|l} & 81 \\ 8 & 6659 \\ & 64 \\ \hline 161 & 259 \\ & 161 \\ \hline & 98 \end{array}$$

$\therefore$ Required number $= 82 \times 82 - 6659 = 65$

**3.** **(e)** Let the numbers be $x$ and $y$

$2x + 3y = 36$

$3x + 2y = 39$

$4x + 6y = 72$

$\underline{9x + 6y = 117}$

$5x = 45$

$\therefore x = 9$

$2 \times 9 + 3y = 36$

$y = \frac{36 - 18}{3} = 6$

$\therefore$ Smaller number is 6

**4.** **(b)** Suppose the two-digit number $= 10x + y$

then, $(10x + y) - 10y + x) = 36$

or, $9(x - y) = 36$ $\therefore x - y = 4$

**5.** **(d)** Let the number be $(10x + 2x)$

$\therefore [10(2x) + x] - [10x + 2x] = 27$

$\Rightarrow 9x = 27$

$\Rightarrow x = 3$

$\therefore$ The original number $= 36$

$\therefore$ 50% of the original number $= 18$

**10.** **(d)** by 101 which is the smallest 3-digit prime number.

**11.** **(b)** The number is $68 \times 269 = 18292$. 18292, when divided by 67, leaves a remainder of 1.

**12.** **(d)** All multiples of 130, i.e., 130, 260, 390, 520, 650, 780, 910.

**13.** **(d)** Let $x$ and $y$ be the numbers,

$\therefore x + y = 20, x - y = 8$

$\Rightarrow x = 14, y = 6$

$\therefore x^2 + y^2 = 14^2 - 6^2$

$= (14 + 6)(14 - 6) \Rightarrow 20 \times 8 = 160$.

**14.** **(c)** Let $x$ and $y$ be the numbers

Such that $x^2 + y^2 = 100$

$x^2 - y^2 = 28$

$\Rightarrow x^2 = 64, \; y^2 = 36$

$\Rightarrow x = 8, \; y = 6$

$\Rightarrow x + y = 14$

**15.** **(a)** $\sqrt{680625} = 825$

**16.** **(a)** We know

$31^2 > 920 > 30^2$ i.e., $961 > 920 > 900$

**17.** **(a)** We have, difference of the two digits $\frac{27}{9} = 3$

Sum of the two digits $= 11$

Now, the two digits are $\frac{11+3}{2}$ and $\frac{11-3}{2}$, i.e., 7 and 4

Thus, the number is 47 because $47 < 74$.

You can check it: $74 - 47 = 27$.

**18.** **(e)** 88

**19.** **(d)** $10x + y - (x + y) = 81$

or, $10x + y - x - y = 81$

or, $9x \Rightarrow 81$ $\therefore x = 9$

hence, all such numbers are as follows: 90, 91, 92, 93, ... 99.

**20.** **(b)** Suppose the number is $x$. Then

$x^2 - 25 = (x - 25)^2$

or, $x^2 - 25 = x^2 - 50x + 625$

or, $50x = 650$

$\therefore x = 13$.

**21.** **(c)** $(10x + y) - (10y + x) = 18$

$\Rightarrow 9(x - y) = 18$

$x - y = 2$

Also, given that $x + y = 10$

$\therefore \quad x = 6$ and $y = 4$

$\therefore$ the number is 64.

**22.** **(a)** Quotient is not given. Hence, remainder cannot be determined.

**23.** **(d)** Suppose the two digit number is $10x + y$

Then, $10y + x = 20x + \frac{y}{2}$

or, $20y + 2x = 40x + y$ or, $y = 2x$.

**24.** **(a)** Let the positive integer be $x$.

Now, $x^2 - 20x = 96$

or, $x^2 - 20x - 96 = 0$

or, $x^2 - 24x + 4x - 96 = 0$

or, $x(x - 24) + 4(x - 4) = 0$

or, $(x - 24)(x + 4) = 0$

or, $x = 24, -4$.

**25.** **(d)** $x \times (x + 2) = 9408$

$x^2 + 2x - 9408 = 0$

$x^2 + 98x - 96x - 9408 = 0$

$x(x + 98) - 96(x + 98) = 0$

$x + 98 = 0, \quad x - 96 = 0$

$x = -98, \quad x + 2 = 96 + 2 = 98$

greater number $= x + 2 = 96 + 2 = 98$.

**26.** **(c)** Let the number be $x$

and, $\frac{1}{8}$ of $\frac{2}{3}$ of $\frac{4}{5} \times x = 12$

$$\therefore \quad \frac{3x}{10} = \frac{3}{10} \times 12 \times 15 = 54.$$

**27.** **(d)** Here neither the remainder nor the dividend nor the second number is given, so number cannot be determined.

**28.** **(a)** Let the two digit number be $10x + y$

Then, $x + y = \frac{1}{5}(10x + y - 10y - x)$

or, $x + y = \frac{9}{5}(x - y)$

or, $4x - 14y = 0 \Rightarrow \frac{x}{y} = \frac{7}{2}$

Using componendo and dividendo, we have

$$\frac{x+y}{x-y} = \frac{7+2}{7-2} = \frac{9}{5}$$

i.e., $x - y = 5k$

Here $k$ has the only possible value, $k = 1$.

Because the difference of two single-digit numbers will always be of a single digit.

**29.** **(d)** Let the number be $x$.

Then, $x - \frac{x}{3} = 48$

$\therefore \quad \frac{2}{3}x = 48.$

**30.** **(d)** Let the three consecutive numbers be $x$, $x + 1$ and $x + 2$ respectively.

$\therefore$ Difference between first and third number

$= x + 2 - x = 2.$

**31.** **(e)** Let the age of Mr Manoj be $(10x + y)$ years.

$\therefore$ His wife's age $= (10y + x)$ years

Then, $(10x + y + 10y + x)\frac{1}{11} = 10x + y - 10y - x$

or, $x + y = 9x - 9y$ or, $8x = 10y$

or, $\frac{x}{y} = \frac{5}{4}$

$\therefore \quad x = 5$ and $y = 4$

[$\because$ any other multiple of 5 will make $x$ of two digits]

$\therefore$ Difference $= 10x + y - 10y - x = 9x - 9y$

$= 9(x - y) = 9(5 - 4) = 9$ years.

**32.** **(d)** Let the number be $x$

$$\therefore \quad \frac{x-4}{6} = 9 \Rightarrow x = 58$$

Again, $\frac{x-3}{5} = \frac{58-3}{5} = \frac{55}{5} = 11.$

**33.** **(a)** Let the two digit number be $10x + y$

$10x + y = 7(x + y) \Rightarrow x = 2y \qquad \cdots(1)$

$10(x + 2) + y + 2 = 6(x + y + 4) + 4$

or, $10x + y + 22 = 6x + 6y + 28$

$\Rightarrow \quad 4x - 5y = 6 \qquad \cdots(2)$

Solving equations (1) and (2), we get $x = 4$, $y = 2$.

**34.** **(b)** $9A^2 = 12A + 96 \Rightarrow 3A^2 - 4A - 32 = 0$

$$\therefore \quad A = \frac{4 \pm \sqrt{16+384}}{6} = 4, \frac{-8}{3}$$

$B^2 = 2B + 3 \Rightarrow B^2 - 2B - 3 = 0$

$$\therefore \quad B = \frac{2 \pm \sqrt{4+12}}{2} = 3, -1$$

$\therefore \quad 5A + 7B = 5 \times 4 + 7 \times 3 = 20 + 21 = 41.$

**35.** **(a)** Let $\frac{1}{2}$ of the number $= 10x + y$ and the number $= 10V + W$

From the given conditions,

$W = x$ and $V = y - 1$

Thus, the number $= 10(y - 1) + x \qquad \cdots(1)$

$\therefore \quad 2(10x + y) = 10(y - 1) + x$

$\Rightarrow \quad 8y - 19x = 10 \qquad \cdots(2)$

Again, from the question,

$V + W = 7 \Rightarrow y - 1 + x = 7$

$\therefore \quad x + y = 8 \qquad \cdots(3)$

Solving equations (2) and (3), we get

$x = 2$ and $y = 6$

$\therefore$ From equation (1)

Number $= 10(y - 1) + x = 52.$

**36.** **(d)** Let the number be '$x$'. Then,

$$\frac{2}{5} \times \frac{1}{3} \times \frac{3}{7} \times x = 15$$

or, $\frac{2x}{35} = 15$ or, $x = \frac{15 \times 35}{2}$

$\therefore$ 40% of $x = \frac{2}{5} \times \frac{15 \times 35}{2} = 105.$

**37.** **(a)** Required number $= \frac{3167 + 4093}{145} = \frac{7260}{145} \approx 50.$

**38.** **(a)** Quotient is not given. Hence, remainder cannot be determined.

**39.** **(a)** Let the positive integer be $x$.

Now, $x^2 - 20x = 96$

or, $x^2 - 20x - 96 = 0$

or, $x^2 - 24x + 4x - 96 = 0$

or, $x(x - 24) + 4(x - 4) = 0$

or, $(x - 24)(x + 4) = 0$

or, $x = 24, -4.$

**40.** **(d)** Let the two consecutive numbers = $x$ and $x + 2$ then sum of their square = $x^2 + (x + 2)^2 = 6500$

$\Rightarrow x^2 + x^2 + 4x + 4 = 6500$

$\Rightarrow 2x^2 + 4x - 6496 = 0$

$\Rightarrow x^2 + 2x - 3248 = 0$

$\Rightarrow x^2 + 58x - 56x - 3248 = 0$

$\Rightarrow x(x + 58) - 56(x + 58) = 0$

$(x + 58)(x - 56) = 0$

$\therefore x = 56$ or, $-58$

**41.** **(d)** Let the first number is $x$ than five consecutive even numbers are $x$, $x + 2$, $x + 4$, $x + 6$, $x + 8$

According to question,

$x + x + 2 + x + 4 + x + 6 + x + 8 = 220$

$\Rightarrow 5x + 20 = 220$

$\Rightarrow 5x = 220 - 20$

$\Rightarrow x = \frac{200}{5} = 40$

Again, suppose different set of five consecutive even number's second lowest number = $y + 2$ which is 37 less than double of the lowest number of Set A

$= 40 \times 2 - 37 = 43$

$\therefore$ First lowest number = $43 - 1 = 42$

and, Sum = $42 + 43 + 44 + 45 + 46$

$= 220$

**42.** **(b)** Suppose the numbers are $x$ and $x + 2$

$\therefore x(x + 2) = 9408$

$\Rightarrow x^2 + 2x - 9408 = 0$

$\Rightarrow x^2 + 98x - 96x - 9408 = 0$

$\Rightarrow x(x + 98) - 96(x + 98) = 0$

$\Rightarrow (x - 96)(x + 98) = 0$

$\Rightarrow x = 96$

$\therefore$ Largest number = $x + 2 = 98$

**43.** **(d)** Suppose the greater number is $x$. Then,

$x(x - 2) = 6888$

$\Rightarrow x^2 - 2x - 6888 = 0$

$\Rightarrow x^2 - 84x + 82x - 6888 = 0$

$\Rightarrow x(x - 84) + 82(x - 84) = 0$

$\Rightarrow (x - 84)(x + 82) = 0$

$\therefore x = 84$ or $-82$

So, the greater number is 84.

**44.** **(b)** Suppose the number is $10x + y$

$\because (10x + y) - (10y + x) = 63$

$\Rightarrow 9x - 9y = 63$

$\Rightarrow x - y = 7$

and, $x + y = 11$

$\because x = 9$

$y = 2$

So, required number = 92

**45.** **(d)** Let the number be $(10x + y)$, then

$10x + y + 10y + x = 11x + 11y$

$= 11(x + y)$

Hence, resultant number will be divisible by 11.

**46.** **(a)** $2^1 = 2$; $2^2 = 4$; $2^3 = 8$; $2^4 = 16$; $2^5 = 32$ i.e., The digits at unit's place repeats itself after power 4.

On dividing 33 by 4, we get 1 as remainder.

Therefore, digit at unit place in the product of 2 = 2

Hence, remainder on division by 10 = 2.

**47.** **(d)** $7^1 = 7$; $7^2 = 49$; $7^3 = 343$; $7^4 = 2401$; $7^5 = 16809$ i.e., The digit at unit place repeats itself after power 4.

On dividing 343 by 4, we get 1 as remainder.

Therefore, unit's digit in the product of $(4387)^{245} = (621)^{72}$ = unit's digits in the product of $(4387)^{245} \times (621)^{+72}$ = units's digits in the product of $(4387)^1 \times (621)^{+2} = 7 \times 1 = 7$.

**48.** **(d)** The sum of two odd numbers is even. The product of two odd numbers is also even. Therefore, $a + b + 2ab$ = Even number.

**49.** **(c)** $2^{16} - 1 = (2^8)^2 - 1$

$= (2^8 + 1)(2^8 - 1)$

$= (256 + 1)(256 - 1)$

$= 257 \times 255 = 65535$

which is exactly divisible by 17.

**50.** **(c)** Let the numbers be $x$ and $y$

Given, $x + y = 24$

and, $xy = 143$

So, $x^2 + y^2 = (x + y)^2 - 2xy$

$= (24)^2 - 2 \times 143$

$= 576 - 286 = 290$

**51.** **(d)** $4^1 = 4$; $4^2 = 16$; $4^3 = 64$; $4^4 = 256$; $4^5 = 1024$

On dividing 372 by 4, the remainder = 0.

On dividing 373 by 4, the remainder = 1.

So, required unit digit

= unit's digit of the sum of 6 + 4 = 0

**52.** **(a)** Let the numbers be $x$ and $y$.

$\therefore \quad (x)(x + y) = 247 \quad \cdots(1)$

and, $\quad (y)(x + y) = 114 \quad \cdots(2)$

On adding (1) and (2), we get

$$x^2 + xy + xy + y^2 = 361$$

$\Rightarrow \quad (x + y)^2 = 361$

$\Rightarrow \quad x + y = 19$

Hence, the sum of numbers is 19.

**53.** **(a)** Let the number be $x$.

$\Rightarrow \quad \frac{1}{7}x - \frac{1}{11}x = 100$

$\Rightarrow \quad \frac{11x - 7x}{77} = 100$

$\Rightarrow \quad 4x = 7700$

$\Rightarrow \quad x = 1925.$

**54.** **(b)** $\sqrt{6 + \sqrt{6 + \sqrt{6 +}}} = ?$

Let $\quad x = \sqrt{6 + \sqrt{6 + \sqrt{6 +}}}$

$\Rightarrow \quad x = \sqrt{6 + x}$

On squaring both the sides,

$$x^2 = 6 + x$$

$\Rightarrow \quad x^2 - x - 6 = 0$

$\Rightarrow \quad x = 3, -2$

Since sum of positive integers cannot be negative, so ignore $-2$.

**55.** **(d)**

$$\begin{array}{ccc} 5 & A & 7 \\ 3 & 3 & 5 \\ \hline 8 & B & 2 \end{array}$$

$8B2$ is exactly divisible by 3.

$\Rightarrow 8 + B + 2 =$ multiple of 3

$\therefore B = 2$ or 5 or 8

Now, $A + 1 + 3 = 8$

$\therefore A = 4.$

**56.** **(c)** $\frac{303375}{25} = \frac{303375 \times 4}{25 \times 4} = \frac{2113500}{100} = 12135$

On multiplying other numbers by 4, the digits at units and tens places will not be zero.

**57.** **(d)** Units digit in $3 \times 38 \times 537 \times 1256$

= Units digit in $3 \times 8 \times 7 \times 6 = 4 \times 2 = 8$

**58.** **(a)** $7^1 = 7$, $7^2 = 49$, $7^3 = 343$, $7^4 = 2401$, $7^5 = 16807$, ...

The units digit repeats itself after index 4.

Units digit in expansion of $(57)^{25}$

= Units digit in $(57)^1 = 7$

$\therefore$ The required units digit $= 7 - 1 = 6$.

**59.** **(c)** Number $(N) = 100x + 10z + y$

$\therefore N - 100x - y$

$= 100x + 10z + y - 100x - y$

$= 10z$

**60.** **(b)** Required remainder = Remainder obtained on dividing the given remainder by 4 = 2.

**Illustration:** If 19 is divided by 4, remainder = 3

If 38 is divided by 4, remainder = 2.

**61.** **(a)** $m^2 - n^2 = (m - n)(m + n)$

Since $(m - n)$ is an even number, $(m + n)$ will also be an even number.

We know that product of two even numbers will always be divisible by 4.

$[(m - n) \times (m + n) = (2 \times 2)(\ldots) = 4\ (\ldots)]$

**62.** **(d)** Since divisor $= a$ (given)

$$\text{Quotient} = \frac{a}{4}$$

$$\text{Remainder} = \frac{a}{2}$$

$\therefore$ Dividend = Divisor $\times$ Quotient + Remainder

$\Rightarrow \quad b = \frac{a \times a}{4} + \frac{a}{2} = \frac{a^2 + 2a}{4} = \frac{a(a+2)}{4}$

$\Rightarrow \quad 4b = a(a+2)$

$\Rightarrow \quad \frac{a(a+2)}{b} = 4.$

**63.** **(c)** A number is exactly divisible by 11, if the difference between the sums of digits at even and odd places be either zero or a multiple of 11.

$\therefore (A + A + 3) - (6 + 8 + 7) = 0$

$\Rightarrow \quad 2A + 3 = 21$

$\Rightarrow \quad 2A = 21 - 3 = 18$

$\therefore \quad A = \frac{18}{2} = 9$

**64.** **(c)** Let the numbers be $a$ and $b$.

$\therefore \quad ab = 1575$ and, $\frac{a}{b} = \frac{9}{7}$

$\therefore \quad ab \times \frac{a}{b} = 1575 \times \frac{9}{7}$

$\Rightarrow \quad a^2 = 2025 \quad \Rightarrow \quad a = \sqrt{2025} = 45$

$\because \quad ab = 1575 \quad \Rightarrow \quad b = \frac{1575}{a} = \frac{1575}{45} = 35$

$\therefore \quad a + b = 45 + 35 = 80.$

**65.** **(c)** Remainder when $(a - 1)^n$ is divided by $a = (-1)^n$

$\therefore 67^{67} + 67 = (68 - 1)^{67}$ is divided by $68 = (-1)^{67} = -1$

$\therefore$ Required remainder $= -1 + 67 = 66$.

**66.** **(c)** Expression $= 3011 \times 3012 = 3011(3011 + 1) = (3011)^2 + 3011$

$\therefore$ Required answer = 3011.

**67.** **(a)** Let the number be $x$. Then,

$x = 296k + 75$

$= (37 \times 8)k + (37 \times 2) + 1$

$= 37 \times 8k + 37 \times 2 + 1$

$= 37 \times (8k + 2) + 1$

$\therefore$ On dividing by 37 the remainder will be 1.

**Quicker Method:**

Required remainder when $75 \div 37 = 1$

**68.** **(c)** Let the numbers be $a$ and $b$.

$\therefore$ Sum of reciprocals $= \dfrac{1}{a} + \dfrac{1}{b} = \dfrac{a+b}{ab}$

$= \dfrac{\text{Sum}}{\text{Product}} = \dfrac{12}{35}$

**69.** **(c)** Since, 5 is the greatest number among 2, 3, 4 and 5.

Therefore, $\sqrt{5}$ is the greatest number among $\sqrt{5}, \sqrt[3]{4}, \sqrt[5]{2}, \sqrt[7]{3}$.

**70.** **(c)** Let the numbers be $x$ and $y$.

$x + y = 7a$; $x - y = 1a$ and $xy = 24a$

On solving, we get

$x = 4a$

$y = 3a$

$\therefore xy = 12a^2 \Rightarrow 12a^2 = 24a \Rightarrow a = 2$

$\therefore$ Required product $= 24 \times 2 = 48$

**71.** **(c)** Total number of items = 32

Maximum number of ice creams = 9

| | | | |
|---|---|---|---|
| So, | 13 | 10 | 9 |
| | 12 | 11 | 9 |

Hence number of cookies is either 10 or 11.

Number of pastries is either 13 or 12.

**72.** **(a)** Let the three consecutive even numbers be $2x$, $2x + 2$ and $2x + 4$.

Then, $(2x)(2x + 2)(2x + 4) = 4032$ ...(1)

Again, product of first and third number $= 2x \times (2x + 4) = 252$ ...(2)

Putting the values of the product of first and third number in equation (1), we have,

$(2x+2) \times 252 = 4032$

or, $2x + 2 = \dfrac{4032}{252} = 16$ or, $2x = 16 - 2 = 14$

$\therefore \quad x = 7$

Hence, first number $= 7 \times 8 = 14$

Second number $= 7 \times 2 + 2 = 16$

and third number $= 7 \times 2 + 4 = 18$

Five times of second number $= 5 \times 16 = 80$.

**73.** **(e)** Average of the nine consecutive odd numbers

$= \dfrac{621}{9} = 69$

So, 69 is the middle number or 5th largest number of Set A.

$\therefore$ Smallest number of Set A will be $69 - 8 = 61$

Lowest number of the set with even numbers $= 61 + 15 = 76$

Sum of the six consecutive even numbers starting with 76

$= \dfrac{6}{2}[(76 \times 2) + (6-1) \times 2] = 3[152 + 10] = 486$

**74.** **(e)** Let the first number be $x$.

According to the question,

$x + x + 2 + x + 4 + x + 6 + x + 8 = 220$

$\Rightarrow \quad 5x = 220 - 20 = 200 \quad \Rightarrow \quad x = 40$

Second lowest number of Set B $= 40 \times 2 - 37 = 43$

Required sum $= 42 + 43 + 44 + 45 + 46 = 220$

**75.** **(a)** Let the first number be $f$ and second number $s$.

Then, $2f + 3s = 100$ ...(1)

$3f + 2s = 120$ ...(2)

Solving (1) and (2), we get

$F = 32$, $s = 12$.

**76.** **(e)** Let $x$ be at the tens place and $y$ at the units place.

Then, $9(x - y) = 54$

$\Rightarrow \quad x - y = 6$ ...(1)

Also, $x + y = 12$ ...(2)

Solving these two equations, we get

$x = 9$ and $y = 3$

The number is $10 \times 9 + 3 = 93$

**77.** **(d)** $9(x - y) = 9 \Rightarrow x - y = 1$ ...(1)

Also, $x + y = 1$ ...(2)

$x \rightarrow$ digit at tens place of the number

$y \rightarrow$ digit at units place of the number

Solving these equations,

we get $x = 8$ and $y = 7$

Now, the number may be either 87 or 78.

So, our best option is (d) Cannot be determined.

**78.** **(c)** $10x + y - 10y - x = 9$

$\Rightarrow \quad 9(x - y) = 9 \quad \Rightarrow \quad x - y = 1.$

# H.C.F. and L.C.M. of Numbers 2

## COMMON FACTOR

A *common factor* of two or more numbers is a number which divides each of them exactly.
For example, 4 is a common factor of 8 and 12.

## HIGHEST COMMON FACTOR

*Highest common factor* of two or more numbers is the greatest number that divides each one of them exactly. For example, 6 is the highest common factor of 12, 18 and 24. Highest Common Factor is also called *Greatest Common Divisor* or *Greatest Common Measure*.

Symbolically, these can be written as H.C.F. or G.C.D. or G.C.M., respectively.

## METHODS OF FINDING H.C.F.

**I. Method of Prime Factors**

**Step 1** Express each one of the given numbers as the product of prime factors.
[A number is said to be a *prime number* if it is exactly divisible by 1 and itself, but not by any other number, e.g., 2, 3, 5, 7, etc. are prime numbers]

**Step 2** Choose common factors.

**Step 3** Find the product of these common factors. This is the required H.C.F. of given numbers.

**Illustration 1:** Find the H.C.F. of 70 and 90.

**Solution:** $70 = 2 \times 5 \times 7$

$90 = 2 \times 5 \times 9$

Common factors are 2 and 5.

$\therefore$ H.C.F. $= 2 \times 5 = 10$.

**Illustration 2:** Find the H.C.F. of 3332, 3724 and 4508.

**Solution:** $3332 = 2 \times 2 \times 7 \times 7 \times 17$

$3724 = 2 \times 2 \times 7 \times 7 \times 19$

$4508 = 2 \times 2 \times 7 \times 7 \times 23$

$\therefore$ H.C.F. $= 2 \times 2 \times 7 \times 7 = 196$.

**Illustration 3:** Find the H.C.F. of 360 and 132.

**Solution:** $360 = 2^3 \times 3^2 \times 5$

$132 = 2^2 \times 3^1 \times 11$

$\therefore$ H.C.F. $= 2^2 \times 3^1 = 12$.

**Illustration 4:** If $x = 2^3 \times 3^5 \times 5^9$ and $y = 2^5 \times 3^7 \times 5^{11}$, find H.C.F. of $x$ and $y$.

**Solution:** The factors common to both $x$ and $y$ are $2^3$, $3^5$ and $5^9$.

$\therefore$ H.C.F. $= 2^3 \times 3^5 \times 5^9$.

**II. Method of Division**

***A. For two numbers*:**

**Step 1** Greater number is divided by the smaller one.

**Step 2** Divisor of (1) is divided by its remainder.

**Step 3** Divisor of (2) is divided by its remainder. This is continued until no remainder is left. H.C.F. is the divisor of last step.

**Illustration 5:** Find the H.C.F. of 3556 and 3444.

```
3444)3556( 1
     3444
     ----
      112)3444( 30
          3360
          ----
            84)112( 1
                84
               ---
                28)84( 3
                   84
                   --
                    ×
                   --
```

$\therefore$ H.C.F. $= 28$.

***B. For more than two numbers*:**

**Step 1** Any two numbers are chosen and their H.C.F. is obtained.

**Step 2** H.C.F. of H.C.F. (of (1)) and any other number is obtained.

**Step 3** H.C.F. of H.C.F. (of (2)) and any other number (not chosen earlier) is obtained. This process is continued until all numbers have been chosen. H.C.F. of last step is the required H.C.F.

**Illustration 6:** Find the H.C.F. of 13915, 9499 and 2553 by division method.

**Solution:**

```
9499) 13915 (1
      9499
      4416) 9499 (2
            8832
            667) 4416 (6
                 4002
                 414) 667 (1
                      414
                      253) 414 (1
                           253
                           161) 253 (1
                                161
                                92) 161 (1
                                    92
                                    69) 92 (1
                                        23
                                        69) 69 (3
                                            69
                                            ×
```

Now, in the next step, we will find the H.C.F. of 23 and 2553.

```
23) 2553 (111
    23
    25
    23
     23
     23
     ×
```

Thus, H.C.F. of 13915, 9499 and 2553 = 23.

**Illustration 7:** Find the greatest possible length which can be used to measure exactly the lengths 7 m, 3 m 85 cm, 12 m 95 cm.

**Solution:** Required length

= (H.C.F. of 700, 385, 1295) cm = 35 cm.

## COMMON MULTIPLE

A *common multiple* of two or more numbers is a number which is exactly divisible by each one of them.
For example, 32 is a common multiple of 8 and 16.

$8 \times 4 = 32$

$16 \times 2 = 32.$

## LEAST COMMON MULTIPLE

The *least common multiple* of two or more given numbers is the least or lowest number which is exactly divisible by each of them.

For example, consider the two numbers 12 and 18.

Multiples of 12 are 12, 24, 36, 48, 60, 72, ...

Multiples of 18 are 18, 36, 54, 72, ...

Common multiples are 36, 72, ...

$\therefore$ Least common multiple, i.e., L.C.M. of 12 and 18 is 36.

# METHODS OF FINDING L.C.M.

**I. Method of Prime Factors**

**Step 1** Resolve each given number into prime factors.

**Step 2** Take out all factors with highest powers that occur in given numbers.

**Step 3** Find the product of these factors. This product will be the L.C.M.

**Illustration 8:** Find the L.C.M. of 32, 48, 60 and 320.

**Solution:** $32 = 2^5 \times 1$

$48 = 2^4 \times 3$

$60 = 2^2 \times 3 \times 5$

$320 = 2^6 \times 6$

$\therefore$ L.C.M. $= 2^6 \times 3 \times 5 = 960.$

**II. Method of Division**

**Step 1** The given numbers are written in a line separated by common.

**Step 2** Divide by any one of the prime numbers 2, 3, 5, 7, 11, ... which will divide at least any two of the given numbers exactly. The quotients and the undivided numbers are written in a line below the first.

**Step 3** Step 2 is repeated until a line of numbers (prime to each other) appears.

**Step 4** Find the product of all divisors and numbers in the last line, which is the required L.C.M.

**Illustration 9:** Find the L.C.M. of 12, 15, 20 and 54.

**Solution:**

| | | | | |
|---|---|---|---|---|
| 2 | 12, | 15, | 20, | 54 |
| 2 | 6, | 15, | 10, | 27 |
| 3 | 3, | 15, | 5, | 27 |
| 5 | 1, | 5, | 5, | 9 |
| | 1, | 1, | 1, | 9 |

L.C.M. $= 2 \times 2 \times 3 \times 5 \times 1 \times 1 \times 1 \times 9$
$= 540$.

*Note:*

Before finding the L.C.M. or H.C.F., we must ensure that all quantities are expressed in the same unit.

## SOME USEFUL SHORTCUT METHODS

**1. H.C.F. and L.C.M. of Decimals**

**Step 1** Make the same number of decimal places in all the given numbers by suffixing zero(s) if necessary.

**Step 2** Find the H.C.F./L.C.M. of these numbers without decimal.

**Step 3** Put the decimal point (in the H.C.F./L.C.M. of Step 2) leaving as many digits on its right as there are in each of the numbers.

**Illustration 10:** Find the L.C.M. of 1.2, 0.24 and 6.

**Solution:** The given numbers can be written as

1.20, 0.24 and 6.00.

Now, ignoring the decimal we find the L.C.M. of

120, 24 and 600.

| | | | |
|---|---|---|---|
| 2 | 120, | 24, | 600 |
| 2 | 60, | 12, | 300 |
| 2 | 30, | 6, | 150 |
| 3 | 15, | 3, | 75 |
| 5 | 5, | 1, | 25 |
| | 1, | 1, | 5 |

$\therefore$ L.C.M. $= 2 \times 2 \times 2 \times 3 \times 5 \times 1 \times 5 = 600$

Thus, the required L.C.M. = 6.00, i.e., 6.

**Illustration 11:** Find the H.C.F. of 6.16 and 13.

**Solution:** The given numbers can be written as 6.16 and 13.00.

Now, ignoring the decimals we find the H.C.F. of 616 and 1300.

```
616 ) 1300 ( 2
      1232
      ----
        68 ) 616 ( 9
             612
             ---
               4 ) 68 ( 17
                   68
                   --
                   ×
```

$\therefore$ H.C.F. of 616 and 1300 is 4.

Thus, the required H.C.F. = 0.04.

**2. L.C.M. and H.C.F. of Fractions**

$$\text{L.C.M} = \frac{\text{L.C.M. of the numbers in numerators}}{\text{H.C.F. of the numbers in denominators}}$$

$$\text{H.C.F.} = \frac{\text{H.C.F. of the numbers in numerators}}{\text{L.C.M. of the numbers in denominators}}$$

**Illustration 12:** Find the L.C.M. of $\frac{2}{5}$, $\frac{3}{10}$ and $\frac{6}{25}$.

**Solution:** L.C.M. of numerators 2, 3 and 6 is 6.

H.C.F. of denominators 5, 10 and 25 is 5.

$$\therefore \quad \text{Required L.C.M.} = \frac{\text{L.C.M. of Numerators}}{\text{H.C.F. of Denominators}} = \frac{6}{5}.$$

**Illustration 13:** Find the H.C.F. of $\frac{4}{9}$, $\frac{10}{21}$ and $\frac{20}{63}$.

**Solution:** H.C.F. of numerators 4, 10 and 20 is 2.

L.C.M. of denominators 9, 21 and 63 is 63.

$$\therefore \quad \text{Required H.C.F} = \frac{\text{H.C.F. of Numerators}}{\text{L.C.M. of Denominators}} = \frac{2}{63}.$$

*Notes:*

1. If the given set of numbers includes fractions as well as whole numbers, treat whole number too as fraction with 1 in its denominator.
2. The H.C.F. of a number of fractions is always a fraction, but the L.C.M. may be a fraction or an integer.

**3. Product of two numbers**
= L.C.M. of the numbers × H.C.F. of the numbers

**Illustration 14:** The H.C.F. and the L.C.M. of any two numbers are 63 and 1260, respectively. If one of the two numbers is 315, find the other number.

**Solution:** The required number

$$= \frac{\text{L.C.M.} \times \text{H.C.F.}}{\text{First Number}} = \frac{1260 \times 63}{315} = 252.$$

> **4.** To find the greatest number that will exactly divide $x$, $y$ and $z$.
> Required number = H.C.F. of $x$, $y$ and $z$.

**Illustration 15:** Find the greatest number that will exactly divide 200 and 320.

**Solution:** The required greatest number

= H.C.F. of 200 and 320 = 40.

> **5.** To find the greatest number that will divide $x$, $y$ and $z$ leaving remainders $a$, $b$ and $c$, respectively.
> Required number = H.C.F. of $(x - a)$, $(y - b)$ and $(z - c)$.

**Illustration 16:** Find the greatest number that will divide 148, 246 and 623 leaving remainders 4, 6 and 11, respectively.

**Solution:** The required greatest number

= H.C.F. of (148 – 4), (246 – 6) and (623 – 11),

i.e., H.C.F. of 144, 240 and 612 = 12.

> **6.** To find the least number which is exactly divisible by $x$, $y$ and $z$.
> Required number = L.C.M. of $x$, $y$ and $z$.

**Illustration 17:** What is the smallest number which is exactly divisible by 36, 45, 63 and 80?

**Solution:** The required smallest number

= L.C.M. of 36, 45, 63 and 80

= 5040.

> **7.** To find the least number which when divided by $x$, $y$ and $z$ leaves the remainders $a$, $b$ and $c$, respectively. It is always observed that $(x - a) = (y - b) = (z - c) = k$(say)
> $\therefore$ Required number = (L.C.M. of $x$, $y$ and $z$) – $k$.

**Illustration 18:** Find the least number which when divided by 36, 48 and 64 leaves the remainders 25, 37 and 53, respectively.

**Solution:** Since, (36 – 25) = (48 – 37) = (64 – 53) = 11, therefore, the required smallest number

= (L.C.M. of 36, 48 and 64) – 11

= 576 – 11 = 565.

> **8.** To find the least number which when divided by $x$, $y$ and $z$ leaves the same remainder $r$ in each case.
> Required number = (L.C.M. of $x$, $y$ and $z$) + $r$.

**Illustration 19:** Find the least number which when divided by 12, 16 and 18, will leave in each case a remainder 5.

**Solution:** The required smallest number

= (L.C.M. of 12, 16 and 18) + 5

= 144 + 5 = 149.

> **9.** To find the greatest number that will divide $x$, $y$ and $z$ leaving the same remainder in each case.
> (a) When the value of remainder $r$ is given:
> Required number = H.C.F. of $(x - r)$, $(y - r)$ and $(z - r)$.
> (b) When the value of remainder is not given:
> Required number = H.C.F. of $|(x - y)|$, $|(y - z)|$ and $|(z - x)|$

**Illustration 20:** Find the greatest number which will divide 772 and 2778 so as to leave the remainder 5 in each case.

**Solution:** The required greatest number

= H.C.F. of (772 – 5) and (2778 – 5)

= H.C.F. of 767 and 2773

= 59.

**Illustration 21:** Find the greatest number which on dividing 152, 277 and 427 leaves equal remainder.

**Solution:** The required greatest number

= H.C.F. of $|(x - y)|$, $|(y - z)|$ and $|(z - x)|$

= H.C.F. of |(152 – 277)|, |(277 – 427)| and |(427 – 152)|

= H.C.F. of 125, 150 and 275

= 25.

> **10.** To find the $n$-digit greatest number which, when divided by $x$, $y$ and $z$,
> (a) leaves no remainder (i.e., exactly divisible)
> **Step 1** L.C.M. of $x$, $y$ and $z = L$
> **Step 2** $\dfrac{L\overline{)\,n\text{-digit greatest number}\,(}}{\text{Remainder} = R}$
> **Step 3** Required number
> = $n$-digit greatest number – $R$
> (b) leaves remainder $K$ in each case
> Required number
> = ($n$-digit greatest number – $R$) + $K$.

**Illustration 22:** Find the greatest number of 4-digit number which, when divided by 12, 18, 21 and 28 leaves 3 as a remainder in each case.

**Solution:** L.C.M. of 12, 18, 21 and 28 = 252.

$$\begin{array}{r} 252\overline{)9999}\ (\ 39 \\ \underline{9828} \\ 171 \end{array}$$

$\therefore$ The required number = (9999 – 171) + 3 = 9931.

**Illustration 23:** Find the greatest number of four digits which, when divided by 12, 15, 20 and 35 leaves no remainder.

**Solution:** L.C.M. of 12, 15, 20 and 35 = 420.

$$\begin{array}{r} 420\overline{)9999}\ (\ 23 \\ \underline{9660} \\ 339 \end{array}$$

$\therefore$ The required number = 9999 – 339
= 9663.

**11.** To find the $n$-digit smallest number which when divided by $x$, $y$ and $z$

(a) leaves no remainder (i.e., exactly divisible)

**Step 1** L.C.M. of $x$, $y$ and $z$ = $L$

**Step 2** $\dfrac{L\overline{)n\text{-digit smallest number}}\ (}{\text{Remainder} = R}$

**Step 3** Required number

= $n$-digit smallest number + $(L - R)$.

(b) leaves remainder $K$ in each case.
Required number
= $n$-digit smallest number + $(L - R) + K$.

**Illustration 24:** Find the least number of four digits which is divisible by 4, 6, 8 and 10.

**Solution:** L.C.M. of 4, 6, 8 and 10 = 120.

$$\begin{array}{r} 120\overline{)1000}(8 \\ \underline{960} \\ 40 \end{array}$$

$\therefore$ The required number = 1000 + (120 – 40)
= 1080.

**Illustration 25:** Find the smallest 4-digit number, such that when divided by 12, 18, 21 and 28, it leaves remainder 3 in each case.

**Solution:** L.C.M. of 12, 18, 21 and 28 = 252.

$$\begin{array}{r} 252\overline{)1000}\ (\ 3 \\ \underline{756} \\ 244 \end{array}$$

$\therefore$ The required number
= 1000 + (252 – 244) + 3
= 1011.

## EXERCISE-I

**1.** What is the H.C.F. of 27, 18 and 36?

(a) 7 (b) 11
(c) 9 (d) None of these

**2.** Determine the L.C.M of $\frac{2}{5}, \frac{3}{10}$ and $\frac{6}{25}$.

(a) $\frac{6}{5}$ (b) $\frac{11}{5}$
(c) $\frac{9}{5}$ (d) None of these

**3.** What is the L.C.M. of 25, 30, 35 and 40?

(a) 3800
(b) 4200
(c) 4400
(d) None of these

**4.** What is the greatest number which divides 852, 1065 and 1491 exactly?

(a) 193 (b) 183
(c) 223 (d) 213

**5.** What is the H.C.F. of $\frac{4}{9}, \frac{10}{21}$ and $\frac{20}{30}$?

(a) $\frac{4}{189}$ (b) $\frac{6}{23}$
(c) $\frac{2}{63}$ (d) None of these

**6.** Find the least number which when divided by 16, 18, 20 and 25 leaves 4 as remainder in each case but when divided by 7 leaves no remainder.

(a) 8004 (b) 13004
(c) 18004 (d) 18014

**7.** Area of three fields is 165 $m^2$, 195 $m^2$ and 85 $m^2$, respectively. In each of the fields a flower bed of equal length has to be made. If flower bed in each of the fields is 3 m wide then what is the maximum length of the flower bed in each of the fields?

(a) 7 m (b) 9 m
(c) 5 m (d) None of these

**8.** Find the greatest number which will divide 2112 and 2792 leaving the remainder 4 in each case.

(a) 78 (b) 68
(c) 65 (d) 63

**9.** The H.C.F. of two numbers is 12 and their difference is 12. The numbers are:

(a) 66, 78 (b) 70, 82
(c) 94, 106 (d) 84, 96

**10.** A merchant has 435 litres, 493 litres and 551 litres of three different kinds of milk. Find the least number of casks of equal size required to store all the milk without mixing.

(a) 51 (b) 61
(c) 47 (d) 45

**11.** Find the greatest number which will divide 25, 73 and 97 so as to leave the same remainder in each case.

(a) 12 (b) 18
(c) 24 (d) 32

**12.** The sum of two numbers is 216 and their H.C.F. is 27. The numbers are:

(a) 54, 162 (b) 108, 118
(c) 27, 189 (d) None of these

**13.** How often will five bells toll together in one hour if they start together and toll at intervals of 5, 6, 8, 12, 20 seconds, respectively?

(a) 29 (b) 30
(c) 31 (d) 120

**14.** Find the greatest number that will divide 964, 1238 and 1400 leaving remainders 41, 31 and 51, respectively.

(a) 71 (b) 81
(c) 61 (d) 73

**15.** Find the side of the largest square slabs which can be paved on the floor of a room 5 m 44 cm long and 3 m 74 cm broad.

(a) 56 (b) 42
(c) 38 (d) 34

**16.** The traffic lights at three different road crossings change after every 48 seconds, 72 seconds and 108 seconds, respectively. If they all change simultaneously at 8:20:00 hours; then they will again change simultaneously at:

(a) 8:27:12 hours
(b) 8:27:24 hours
(c) 8:27:36 hours
(d) 8:27:48 hours

**17.** The product of two numbers is 6760 and their H.C.F. is 13. How many such pairs can be formed?

(a) 2 (b) 3
(c) 4 (d) only one

**18.** Find the greatest number of four digits which when divided by 10, 15, 21 and 28 leaves 4, 9, 15 and 22 as remainders, respectively.

(a) 9654 (b) 9666
(c) 9664 (d) 9864

**19.** The number of prime factors in the expression $(6)^{10} \times (7)^{17} \times (11)^{27}$ is:

(a) 54 (b) 64
(c) 71 (d) 81

**20.** Find the greatest number which will divide 3962, 4085 and 4167 leaving the same remainder in each case.

(a) 37 (b) 39
(c) 41 (d) 43

**21.** A wholesale tea dealer has 408 kilograms, 468 kilograms and 516 kilograms of three different qualities of tea. He wants it all to be packed into boxes of equal size without mixing. Find the capacity of the largest possible box.

(a) 50 (b) 36
(c) 24 (d) 12

**22.** A room is 4 m 37 cm long and 3 m 23 cm broad. It is required to pave the floor with minimum square slabs. Find the number of slabs required for this purpose.

(a) 485 (b) 431
(c) 391 (d) 381

**23.** The least perfect square number which is divisible by 3, 4, 5, 6 and 8:

(a) 900 (b) 1200
(c) 2500 (d) 3600

**24.** Find the least number of five digits which when divided by 12, 16, 21, 36 and 40 leaves remainder 8 in each case.

(a) 10088 (b) 10072
(c) 10080 (d) None of these

**25.** Three pieces of timber 42 m, 49 m and 63 m long have to be divided into planks of the same length. What is the greatest possible length of each plank?

(a) 7 m (b) 14 m
(c) 42 m (d) 63 m

**26.** Three men start together to travel the same way around a circular track of 11 kilometres in circumference. Their speeds are 4, $5\frac{1}{2}$ and 8 Km/h, respectively. When will they meet at the starting point?

(a) 11 hours (b) 12 hours
(c) 23 hours (d) 22 hours

**27.** Five bells begin to toll together and toll at intervals of 36, 45, 72, 81 and 108 seconds. After what interval of time will they keep on tolling together?

(a) 3240 seconds (b) 3080 seconds
(c) 3140 seconds (d) 3200 seconds

**28.** Three different containers contain different quantities of mixture of milk and water, whose measurements are 403 Kg, 434 Kg and 465 Kg. What biggest measure must be there to measure all the different quantities exactly?

(a) 1 Kg (b) 7 Kg
(c) 31 Kg (d) 41 Kg

**29.** The L.C.M. and G.C.D. of two numbers are 1530 and 51, respectively. Find how many such pairs are possible?

(a) 2 (b) 3
(c) 4 (d) Only one

**30.** Find the least number of five digits which when divided by 63, 56 and 42 leaves remainder 1 in each case.

(a) 10082 (b) 10081
(c) 10001 (d) 10071

**31.** The H.C.F. and L.C.M. of two numbers are 44 and 264, respectively. If the first number is divided by 2, the quotient is 44. The other number is:

(a) 33 (b) 66
(c) 132 (d) 264

**32.** The largest natural number which exactly divides the product of any four consecutive natural numbers, is:

(a) 6 (b) 12
(c) 24 (d) 120

**33.** Find the least number of six digits which is exactly divisible by 15, 21 and 28:

(a) 100480 (b) 100270
(c) 100380 (d) 100340

**34.** Find the greatest number of five digits which when divided by 12, 15, 21, 25 and 28 leaves 5, 8, 14, 18 and 21 as remainders, respectively.

(a) 98696 (b) 98700
(c) 97693 (d) 98693

**35.** What is the smallest number which when increased by 3 is divisible by 16, 24, 30 and 32?

(a) 480 (b) 475
(c) 472 (d) 477

**36.** The least number of square tiles required to cover the ceiling of a room 15 m 17 cm long and 9 m 2 cm broad, is:

(a) 656 (b) 738
(c) 814 (d) 902

**37.** Find the least number which when divided by 2, 3, 4, 5 and 6 leaves 1, 2, 3, 4 and 5 as remainders, respectively, but when divided by 7 leaves no remainder.

(a) 210 (b) 119
(c) 126 (d) 154

**38.** Find the greatest number of five digits which when divided by 4, 6, 10 and 15 leaves the same remainder 3 in each case.

(a) 99993 (b) 99063
(c) 90093 (d) 99963

**39.** Find the least number which is a multiple of 31 and when divided by 15, 24 and 32 leaves the remainders 2, 11 and 19, respectively.

(a) 2418 (b) 2387
(c) 2356 (d) 2325

**40.** Find the two largest numbers of four digits having 531 as their H.C.F.

(a) 9231, 9762
(b) 9027, 9558
(c) 9037, 9568
(d) 9127, 9658

**41.** Find the greatest number of five digits which becomes exactly divisible by 10, 12, 15 and 18 when 3769 is added to it.

(a) 99811 (b) 99911
(c) 98911 (d) 99011

**42.** Find the least number which when decreased by 11 is divisible by 14, 15, 21, 32 and 60.

(a) 4371 (b) 3271
(c) 3371 (d) 3360

**43.** Find the least number of five digits which when divided by 8, 12, 16 and 20 leaves remainders 1, 5, 9 and 13, respectively.

(a) 10003 (b) 10093
(c) 10073 (d) 10013

**44.** The H.C.F. of two numbers is 11 and their L.C.M. is 693. If one of the numbers is 77, find the other.

(a) 909 (b) 119
(c) 66 (d) 99

**45.** Find the greatest number of four digits which is exactly divisible by 24, 28, 30 and 35.

(a) 9225 (b) 9240
(c) 9250 (d) 9260

**46.** Find the greatest number of four digits which must be added to 5231 so that the final number becomes exactly divisible by 12, 15, 27, 32 and 40.

(a) 7929 (b) 7829
(c) 9729 (d) 7729

**47.** A heap of stones can be made up into groups of 21. When made up into groups of 16, 20, 25 and 45, there are 3 stones left in each case. How many stones at least can there be in the heap?

(a) 7203 (b) 2403
(c) 3603 (d) 4803

**48.** Find the greatest number of five digits which when divided by 8, 9 and 10 leaves 3 as remainder in each case.

(a) 99996
(b) 99723
(c) 99983
(d) None of these

**49.** What is the least number of cut pieces of equal length that can be cut out of two lengths 10 m 857 mm and 15 m 87 mm?

(a) 174 (b) 172
(c) 164 (d) 184

## EXERCISE-2
## (BASED ON MEMORY)

**1.** The sum of two numbers is 45. Their difference is $\frac{1}{9}$ of their sum. Their L.C.M. is:

(a) 200 (b) 250
(c) 100 (d) 150

**[SSC (GL) Prel. Examination, 2007]**

**2.** The sum of the H.C.F. and L.C.M. of two numbers is 680 and the L.C.M. is 84 times the H.C.F. If one of the numbers is 56, then the other is:

(a) 84 (b) 12
(c) 8 (d) 96

**[SSC (GL) Prel. Examination, 2005]**

**3.** The L.C.M. and H.C.F. of the numbers 28 and 42 are in the ratio:

(a) 6:1 (b) 2:3
(c) 3:2 (d) 7:2

**[SSC (GL) Prel. Examination, 2000]**

**4.** The L.C.M. of two numbers is 1820 and their H.C.F. is 26. If one number is 130 then the other number is:

(a) 70 (b) 1690
(c) 364 (d) 1264

**[SSC (GL) Prel. Examination, 2002]**

**5.** H.C.F. and L.C.M. of two numbers are 7 and 140, respectively. If the numbers are between 20 and 45, the sum of the numbers is:

(a) 70 (b) 77
(c) 63 (d) 56

**[SSC (GL) Prel. Examination, 2003]**

**6.** The L.C.M. of two numbers is 14560 and their H.C.F. is 13. If one of them is 416, then the other is:

(a) 460 (b) 455
(c) 450 (d) 446

**[SSC (GL) Prel. Examination, 2002]**

**7.** The ratio of two numbers is 3:4 and their H.C.F. is 4. Their L.C.M. is:

(a) 12 (b) 16
(c) 24 (d) 48

**[SSC (GL) Prel. Examination, 2002]**

**8.** The H.C.F. of two numbers is 16 and their L.C.M. is 160. If one of the numbers is 32, then other number is:

(a) 48 (b) 80
(c) 96 (d) 112

**[SI of Police Rec. Examination, 1997]**

**9.** The H.C.F. of two numbers is 24. The number, which can be their L.C.M., is:

(a) 84 (b) 120
(c) 128 (d) 148

**[Assitant's Grade Examination, 1997]**

**10.** H.C.F. of $4 \times 27 \times 3125$, $8 \times 9 \times 25 \times 7$ and $16 \times 81 \times 5 \times 11 \times 49$ is:

(a) 180 (b) 360
(c) 540 (d) 1260

**[SI of Police Rec. Examination, 1997]**

**11.** The sum of two numbers is 528 and their H.C.F. is 3. The number of such pairs is:

(a) 2 (b) 3
(c) 4 (d) 5

**[SI of Police Rec. Examination, 1997]**

**12.** The L.C.M. of two numbers is 1920 and their H.C.F., is 16. If one of the numbers is 128, find the other number.

(a) 204 (b) 240
(c) 260 (d) 320

**[SI of Police Rec. Examination, 1997]**

**13.** The H.C.F. and L.C.M. of two numbers are 11 and 385 respectively. If one number lies between 75 and 125, then that number is:

(a) 77 (b) 88
(c) 99 (d) 110

**[SI Rec. COP Examination, 1998]**

**14.** The sum of two numbers is 2000 and their L.C.M. is 21879. The two numbers are:

(a) 1993, 7 (b) 1991, 9
(c) 1989, 11 (d) 1987, 13

**[Assistant's Grade Examination, 1998]**

**15.** The L.C.M. of two numbers is 495 and their H.C.F. is 5. If the sum of two numbers is 100 then their difference is:

(a) 10 (b) 46
(c) 70 (d) 90

**[SSC (GL) Prel. Examination, 1999]**

**16.** L.C.M. of two numbers is 225 and their H.C.F. is 5. If one number is 25, the other number will be:

(a) 5 (b) 25
(c) 45 (d) 225

**[SSC (GL) Prel. Examination, 1999]**

**17.** The H.C.F. of two numbers is 8. Which one of the following can never be their L.C.M.?

(a) 24 (b) 48
(c) 56 (d) 60

**[SSC (GL) Prel. Examination, 2000]**

**18.** The L.C.M. of two numbers is 1820 and their H.C.F. is 26. If one number is 130 then the other number is:

(a) 70 (b) 1690
(c) 364 (d) 1264

**[SSC (GL) Prel. Examination, 2002]**

**19.** H.C.F. and L.C.M. of two numbers are 7 and 140, respectively. If the numbers are between 20 and 45, the sum of the numbers is:

(a) 70 (b) 77
(c) 63 (d) 56

**[SSC (GL) Prel. Examination, 2003]**

**20.** L.C.M. of two numbers is 495 and their H.C.F. is 5. If the sum of two numbers is 100 then their difference is:

(a) 10 (b) 46
(c) 70 (d) 90

**[SSC (GL) Prel. Examination, 1999]**

**21.** Philip, Tom and Brad start jogging around a circular field and complete a single round in 18 seconds, 22 seconds and 30 seconds, respectively. In how much time, will they meet again at the starting point?

(a) 3 minutes 15 seconds
(b) 21 minutes
(c) 16 minutes 30 seconds
(d) 12 minutes

**[Indian Bank PO, 2011]**

**22.** Amit, Sucheta and Neeti start running around a circular track and complete one round in 18 seconds, 24 seconds and 32 seconds, respectively. In how many seconds will the three meet again at the starting point if they all have started running at the same time?

(a) 196 (b) 288
(c) 324 (d) Cannot be determined

**[Bank of India PO, 2010]**

**23.** Three friends A, B and C start running around a circular stadium and complete a single round in 24 seconds, 36 seconds and 30 seconds, respectively. After how many minutes will they meet again at the starting point?

(a) 12 (b) 6
(c) 8 (d) 15

**[IDBI PO, 2009]**

**24.** Seema, Meena and Reena start jogging around a circular stadium and complete one round in 54 seconds, 42 seconds and 63 seconds, respectively. Approximately after how many minutes they will meet again at the starting point?

(a) 8 (b) 10
(c) 3 (d) 6

**[Syndicate Bank PO, 2010]**

**25.** L.C.M. and H.C.F. of two numbers $x$ and $y$ are 3 and 105, respectively. If $x + y = 36$, the value of $\frac{1}{x}+\frac{1}{y}$ is:

(a) 1 (b) $\frac{1}{6}$
(c) $\frac{12}{315}$ (d) $\frac{4}{35}$

**[UPPCS, 2012]**

**26.** The greatest number, which when subtracted from 5834, gives a number exactly divisible by each of 20, 28, 32 and 35, is:

(a) 1120 (b) 4714
(c) 5200 (d) 5600

**[SSC (GL), 2010]**

**27.** H.C.F. and L.C.M. of two numbers are 8 and 48, respectively. If one of the numbers is 24, then the other number is:

(a) 48 (b) 36
(c) 24 (d) 16

**[SSC (GL), 2010]**

**28.** Two numbers are in the ratio 3:4. Their L.C.M. is 84. The greater number is:

(a) 21 (b) 24
(c) 28 (d) 84

**[SSC (GL), 2010]**

**29.** H.C.F. and L.C.M. of two numbers are 12 and 924, respectively. Then the number of such pairs is:

(a) 0 (b) 1
(c) 2 (d) 3

**[SSC (GL), 2011]**

**30.** What is the least number which, when divided by 5, 6, 7, 8 gives the remainder 3 but is divisible by 9?

(a) 1463 (b) 1573
(c) 1683 (d) 1793

**[SSC (GL), 2011]**

**31.** L.C.M. of two numbers is 120 and their H.C.F. is 10. Which of the following can be the sum of those two numbers?

(a) 140 (b) 80
(c) 60 (d) 70

**[SSC (GL), 2011]**

**32.** The traffic lights at three different road crossings change after 24 seconds, 36 seconds and 54 seconds, respectively. If they, all change simultaneously at 10:15:00 am, then at what time will they again change simultaneously?

(a) 10:16:54 am (b) 10:18:36 am
(c) 10:17:02 am (d) 10:22:12 am

**[SSC (GL), 2011]**

**33.** Find the least number which when divided separately by 15, 20, 36 and 48 leaves 3 as remainder in each case.

(a) 183 (b) 243
(c) 483 (d) 723

**[SSC, 2014]**

**34.** If the L.C.M. and H.C.F. of two expressions are $(x^2+6x+8)(x+1)$ and $(x+1)$, respectively and one of the expressions is $x^2+3x+2$, find the other.

(a) $x^2+5x+4$ (b) $x^2-5x+4$
(c) $x^2+4x+5$ (d) $x^2-4x+5$

**[SSC, 2014]**

**35.** What is the smallest number by which 625 must be divided so that the quotient is a perfect cube?

(a) 125 (b) 5
(c) 2 (d) 3

**[SSC, 2014]**

**36.** Find the greatest number which exactly divides 200 and 320.

(a) 10 (b) 20
(c) 16 (d) 40

**[SSC, 2014]**

**37.** The greatest 4-digit number exactly divisible by 10, 15 and 20 is:

(a) 9990 (b) 9960
(c) 9980 (d) 9995

**[SSC, 2013]**

**38.** If the students of 9th class are arranged in rows of 6, 8, 12 or 16, no student is left behind. The possible number of students in the class is:

(a) 60 (b) 72
(c) 80 (d) 96

**[SSC, 2013]**

**39.** If $A$ and $B$ are the H.C.F. and L.C.M., respectively of two algebraic expressions $x$ and $y$, and $A + B = x + y$, then the value of $A^3 + B^3$ is:

(a) $x^3 - y^3$
(b) $x^3$
(c) $y^3$
(d) $x^3 + y^3$

**[SSC Assistant Grade III, 2013]**

**40.** The greatest number that divides 411, 684, 821 and leaves 3, 4 and 5 as remainders, respectively is:

(a) 254 (b) 146
(c) 136 (d) 204

**[SSC Assistant Grade III, 2013]**

**41.** Given: $\sqrt[3]{4}$, $\sqrt{3}$, $\sqrt[6]{25}$ and $\sqrt[12]{289}$, the greatest and least of them are respectively:

(a) $\sqrt[12]{289}$ and $\sqrt[3]{4}$
(b) $\sqrt{3}$ and $\sqrt[3]{4}$
(c) $\sqrt[6]{25}$ and $\sqrt{3}$
(d) $\sqrt[3]{4}$ and $\sqrt[6]{25}$

**[SSC Assistant Grade III, 2012]**

**42.** In four consecutive prime numbers that are in ascending order, the product of the first three is 385 and that of the last three is 1001. The largest given prime number is:

(a) 11 (b) 13
(c) 17 (d) 19

**[SSC, 2012]**

**43.** H.C.F. of $\frac{2}{3}, \frac{4}{5}$ and $\frac{6}{7}$ is:

(a) $\frac{48}{105}$ (b) $\frac{2}{105}$
(c) $\frac{1}{105}$ (d) $\frac{24}{105}$

**[SSC, 2012]**

**44.** There are five bells which start ringing together at intervals of 3, 6, 9, 12 and 15 seconds respectively. In 36 minutes, how many times will the bells ring simultaneously?

(a) 13 (b) 12
(c) 6 (d) 5

**[SSC, 2012]**

**45.** Two numbers are in the ratio 5:6. If their H.C.F. is 4, then their L.C.M. will be:

(a) 90 (b) 96
(c) 120 (d) 150

**[SSC, 2010]**

**46.** A number, when divided successively by 4, 5 and 6, leaves remainders 2, 3 and 4 respectively. The least such number is:

(a) 50 (b) 53
(c) 58 (d) 214

**[SSC, 2010]**

**47.** The greatest number that divides 43, 91 and 183 so as to leave the same remainder in each case, is:

(a) 9 (b) 8
(c) 4 (d) 3

**[SSC, 2010]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (a) | **3.** (b) | **4.** (d) | **5.** (c) | **6.** (c) | **7.** (c) | **8.** (b) | **9.** (d) | **10.** (a) | **11.** (c) | **12.** (c) | **13.** (c) |
| **14.** (a) | **15.** (d) | **16.** (a) | **17.** (a) | **18.** (a) | **19.** (b) | **20.** (c) | **21.** (d) | **22.** (c) | **23.** (d) | **24.** (a) | **25.** (a) | **26.** (d) |
| **27.** (a) | **28.** (c) | **29.** (c) | **30.** (b) | **31.** (c) | **32.** (c) | **33.** (c) | **34.** (d) | **35.** (d) | **36.** (c) | **37.** (b) | **38.** (d) | **39.** (b) |
| **40.** (b) | **41.** (b) | **42.** (c) | **43.** (c) | **44.** (d) | **45.** (b) | **46.** (d) | **47.** (a) | **48.** (b) | **49.** (d) | | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (d) | **3.** (a) | **4.** (c) | **5.** (c) | **6.** (b) | **7.** (d) | **8.** (b) | **9.** (b) | **10.** (c) | **11.** (c) | **12.** (b) | **13.** (a) |
| **14.** (c) | **15.** (a) | **16.** (c) | **17.** (d) | **18.** (c) | **19.** (c) | **20.** (a) | **21.** (c) | **22.** (b) | **23.** (b) | **24.** (d) | **25.** (d) | **26.** (b) |
| **27.** (d) | **28.** (c) | **29.** (c) | **30.** (c) | **31.** (d) | **32.** (b) | **33.** (d) | **34.** (a) | **35.** (a) | **36.** (d) | **37.** (b) | **38.** (d) | **39.** (d) |
| **40.** (c) | **41.** (b) | **42.** (b) | **43.** (b) | **44.** (a) | **45.** (c) | **46.** (c) | **47.** (c) | | | | | |

## EXPLANATORY ANSWERS

### EXERCISE-1

**1. (c)** H.C.F. of 27, 18 and 36

$$\begin{array}{l} 18\,)\;27\;(\,1 \\ \qquad 18 \\ \hline \qquad 9\,)\;18\;(\,2 \\ \qquad\qquad 18 \\ \hline \qquad\qquad \times \end{array}$$

$\therefore$ H.C.F. of 27 and 18 is 9

Now, H.C.F. of 9 and 36

$$\begin{array}{l} 9\,)\;36\;(\,4 \\ \qquad 36 \\ \hline \qquad \times \end{array}$$

$\therefore$ H.C.F. of 9 and 36 is 9

Therefore, the required H.C.F of 27, 18 and 36 is 9.

**2. (a)** L.C.M. of $\frac{2}{5}, \frac{3}{10}$ and $\frac{6}{25}$

$$= \frac{\text{L.C.M. of 2, 3 and 6}}{\text{H.C.F. of 5, 10 and 25}}$$

$\because$ L.C.M. of 2, 3 and 6 = 6

and, H.C.F. of 5, 10 and 25 = 5

$\therefore$ Required L.C.M. = $\frac{6}{5}$.

**3. (b)**

$$\begin{array}{c|cccc} 2 & 25, & 30, & 35, & 40 \\ \hline 5 & 25, & 15, & 35, & 20 \\ \hline & 5, & 3, & 7, & 4 \end{array}$$

$\therefore$ Required L.C.M. = $2 \times 5 \times 5 \times 3 \times 7 \times 4$

= 4200.

**4. (d)** H.C.F. of 852 and 1065 is 213.

H.C.F. of 213 and 1491 is 213.

**5. (c)** H.C.F. of $\frac{4}{9}, \frac{10}{21}$ and $\frac{20}{63}$

$$= \frac{\text{H.C.F. of 4, 10 and 20}}{\text{L.C.M. of 9, 21 and 63}}$$

$\because$ H.C.F. of 4, 10 and 20 = 2

and L.C.M. of 9, 21 and 63 = 63

$\therefore$ Required H.C.F. = $\frac{2}{63}$.

**6. (c)** L.C.M. of 16, 18, 20 and 25 is 3600.

Required number = $3600 \times K + 4$

$= (7 \times 514 + 2)K + 4$

$= (7 \times 514)K + 2K + 4$

Now $(2K + 4)$ is divisible by 7 for $K = 5$.

$\therefore$ Required number = $5 \times 3600 + 4$

= 18004.

**7. (c)** H.C.F. of 165, 195 and 85 will be maximum area of each of the flower beds.

H.C.F. of 165 and 195:

$$\begin{array}{l} 165\,)\;195\;(\,1 \\ \qquad\;\; 165 \\ \hline \qquad\;\; 30\,)\;165\;(\,2 \\ \qquad\qquad\quad 150 \\ \hline \qquad\qquad\quad 15\,)\;35\;(\,2 \\ \qquad\qquad\qquad\quad 30 \\ \hline \qquad\qquad\qquad\quad \times \end{array}$$

$\therefore$ H.C.F. of 165 and 195 is 15.

Also, now, H.C.F. of 15 and 85 is 5.

**8. (b)** Subtract 4 from each of the numbers 2112 and 2792 and then take the H.C.F, i.e., H.C.F of 2108 and 2788.

**9. (d)** The difference of requisite numbers must be 12 and each one must be divisible by 12. So, the numbers are 84, 96.

**10. (a)** Since minimum number of casks are required, the size of the cask is greatest. Also the cask in three cases are of equal size. The size of the cask is the H.C.F. of 435, 493 and 551 which is 29.

Now, the number of casks required for storing the milk

$= (493 + 435 + 551) \div 29 = 51.$

**11. (c)** $73 - 25 = 48$

$97 - 73 = 24$

$97 - 25 = 72$

H.C.F. of 48, 24 and 72 is 24.

**12. (c)** Let the numbers be $27a$ and $27b$

Then, $27a + 27b = 216$ or, $27(a + b) = 216$

or, $a + b = \frac{216}{27} = 8$

$\therefore$ Values of co-primes (with sum 8) are (1, 7) and (3, 5)

So, the numbers are $(27 \times 1, 27 \times 7)$,

i.e., (27, 189).

**13. (c)** The time after which the bells will ring together is the L.C.M. of 5, 6, 8, 12 and 20 seconds, i.e., 120 seconds. The number of times they will toll together in one hour

$= (3600 \div 120) + 1$

$= 30 + 1 = 31.$

**14. (a)** $964 - 41 = 923$

$1238 - 31 = 1207$

$1400 - 51 = 1349$

H.C.F. of 923 and 1207 is 71.

H.C.F. of 71 and 1349 is 71.

**15.** **(d)** The side of the square slab is the H.C.F. of 544 and 374 cm, i.e., 34.

**16.** **(a)** Interval of change = (L.C.M. of 48, 72, 108) seconds = 432

So, the lights will change after every 432 seconds, i.e., 7 minutes and 12 seconds.

So, the next simultaneous change will take place at 8:27:12 hours.

**17.** **(a)** Let the numbers be $13x$ and $13y$.

$$13x \times 13y = 6760$$

$\therefore \quad x \times y = 6760 \div (13 \times 13) = 40$

Possible values of $(x, y)$ are

(1, 40); (2, 20); (4, 10); (5, 8)

Only two acceptable values are (1, 40) and (5, 8).

**18.** **(a)** First, find the greatest number of four digits that is divisible by the L.C.M. of 10, 15, 21 and 28 and then subtract 6 from it to get the required number.

**19.** **(b)** Since 2, 3, 7, 11 are prime numbers and the given expression is $2^{10} \times 3^{10} \times 7^{17} \times 11^{27}$, the number of prime factors in the given expression is (10 + 10 + 17 + 27) = 64.

**20.** **(c)** 4085 – 3962 = 123

4167 – 4085 = 82

4167 – 3962 = 205

H.C.F. of 123, 82 and 205 is 41.

**21.** **(d)** The capacity of the box is H.C.F. of 408, 468 and 516, i.e., 12.

**22.** **(c)** Length = 437 cm

Breadth = 323 cm.

The side of the square slab is the H.C.F. of 437 and 323, i.e., 19 cm.

$\therefore \quad$ Area of square slab = 19 cm × 19 cm = 361 cm$^2$

$$\text{The number of slabs} = \frac{\text{Area of the room}}{\text{Area of the slab}} = \frac{437 \times 323 \text{ cm}^2}{361 \text{ cm}^2} = 391.$$

**23.** **(d)**

| | | | | | |
|---|---|---|---|---|---|
| 2 | 3, | 4, | 5, | 6, | 8 |
| 2 | 3, | 2, | 5, | 3, | 4 |
| 3 | 3, | 1, | 5, | 3, | 2 |
| | 1, | 1, | 5, | 1, | 2 |

L.C.M. of 3, 4, 5, 6, 8 = 120

Required number = 2 × 2 × 2 × 2 × 3 × 3 × 5 × 5 = 3600.

**24.** **(a)** Required number = the least number of 5 digits divisible by the L.C.M. of 12, 16, 21, 36, 40 + the remainder 8.

**25.** **(a)** Greatest possible length of each plank

= (H.C.F. of 42, 49, 63) m = 7 m.

**26.** **(d)** Time for one revolution by each of three men

$$= \frac{11}{4}, \frac{11}{5\frac{1}{2}}, \frac{11}{8} \text{ hours}$$

$$= \frac{11}{4}, \frac{2}{1}, \frac{11}{8} \text{ hours}$$

$\therefore \quad$ The time when they will meet at the starting point

$= \text{L.C.M. of } \frac{11}{4}, \frac{2}{1}, \frac{11}{8}$ which is $\frac{22}{1}$, i.e., 22 hours.

**27.** **(a)** The interval of time is L.C.M. of the numbers 36, 45, 72, 81 and 108.

| | | | | | |
|---|---|---|---|---|---|
| 2 | 36, | 45, | 72, | 81, | 108 |
| 2 | 18, | 45, | 36, | 81, | 54 |
| 2 | 9, | 45, | 18, | 81, | 27 |
| 3 | 9, | 45, | 9, | 81, | 27 |
| 3 | 3, | 15, | 3, | 27, | 9 |
| 3 | 1, | 5, | 1, | 9, | 3 |
| | 1, | 5, | 1, | 3, | 1 |

L.C.M. (36, 45, 72, 108) = 3240.

**28.** **(c)** Biggest measure = H.C.F. of (403, 434, 465)

= 31 Kg.

**29.** **(c)** Let the numbers be $51x$ and $51y$ where $x$ and $y$ are co-prime.

Now, $51x \times 51y = 51 \times 1530$

$\therefore \quad x \times y = 30$

Possible pairs are (1, 30); (2, 15); (3, 10) and (5, 6).

**30.** **(b)** L.C.M. of 63, 56 and 42 is 504.

Least number of 5 digits divisible by 504:

```
504 ) 10000 ( 19
      –504
       4960
      –4536
        424
```

= 1000 + (504 – 424) = 10080

$\therefore \quad$ Required number = 10080 + 1 = 10081.

**31.** **(c)** First number = 2 × 44 = 88

$$\text{Second number} = \frac{44 \times 264}{88} = 132.$$

**32.** **(c)** 1 × 2 × 3 × 4 = 24

$\therefore \quad$ Required number = 24.

**33.** **(c)** L.C.M. of 15, 21 and 28 is 420.

Least number of 6 digits = 100000

$$\begin{array}{r|l}
420 & 100000\,(238 \\
 & -840 \\ \hline
 & \;\;1600 \\
 & -1260 \\ \hline
 & \;\;\;3400 \\
 & -3360 \\ \hline
 & \;\;\;\;\;40
\end{array}$$

Remainder = 40.

∴ Least number = 100000 + (420 − 40)

= 100380.

**34.** **(d)** Find the greatest number of five digits which is divisible by the L.C.M. of 12, 15, 21, 25 and 28 and then subtract 7 from it to get the required number.

Required number = 98700 − 7 = 98693.

**35.** **(d)** Required number

= (L.C.M. of 16, 24, 30 and 32) − 3

= 480 − 3 = 477.

**36.** **(c)** Side of each tile = (H.C.F. of 1517 and 902) cm = 41 cm

∴ Number of tiles = $\dfrac{1517 \times 902}{41 \times 41}$ = 814.

**37.** **(b)** L.C.M. of 2, 3, 4, 5, 6 is 60.

One of the numbers satisfying the first condition is 60 – 1 = 59

60 + 59 = 119, etc.

But 119 is also divisible by 7.

**38.** **(d)** L.C.M. of 4, 6, 10, 15 = 60

Greatest number of five digits which is divisible by 60 = 99960.

∴ Required number = 99960 + 3 = 99963.

**39.** **(b)** L.C.M. of 15, 24, 32 is 480

Required number = 480$K$ − 13

= 15 × 31$K$ + (15$K$ − 13)

(15$K$ − 13) is divisible by 31 for $K$ = 5

∴ Least number = 480 × 5 − 13 = 2387.

**40.** **(b)** The greatest number of four digits divisible by 531 is 9558, so the other number is 9558 – 531 = 9027. Thus, the numbers are 9558 and 9027.

**41.** **(b)** L.C.M. of 10, 12, 15 and 18 = 540. Dividing (99999 + 3769) by 540, the remainder is 88.

∴ Required number = 99999 − 88 = 99911.

**42.** **(c)** Required number

= (L.C.M. of 14, 15, 21, 32, 60) + 11

= 3360 + 11 = 3371.

**43.** **(c)** Least number of five digits divisible by L.C.M. of 8, 12, 16, 20 is 10080.

∴ Required number = 10080 − 7 = 10073.

**44.** **(d)** Required number = $\dfrac{\text{L.C.M.} \times \text{H.C.F.}}{\text{Given number}}$

= $\dfrac{693 \times 11}{77}$ = 99.

**45.** **(b)** L.C.M. of 24, 28, 30 and 35

| | | | | |
|---|---|---|---|---|
| 2 | 24, | 28, | 30, | 35 |
| 2 | 12, | 14, | 15, | 35 |
| 3 | 6, | 7, | 15, | 35 |
| 5 | 2, | 7, | 5, | 35 |
| 7 | 2, | 7, | 1, | 7 |
| | 2, | 1, | 1, | 1 |

= 2 × 2 × 2 × 3 × 5 × 7 = 840

Greatest number of four digits

= 9999.

Quotient when 9999 is divided by 840 is 11 and remainder is 759.

∴ Greatest number of four digits in this case = 9999 − 759 = 9240.

**46.** **(d)** L.C.M. of 12, 15, 27, 32, 40 = 4320. Let us add 5231 to the greatest number of four digits and then divide by 4320 to find the remainder.

$$\begin{array}{r|l}
4320 & 15230\,(3 \\
 & 12960 \\ \hline
 & \;\;2270
\end{array}$$

Required greatest number of four digits

= 9999 − 2270

= 7729.

**47.** **(a)** L.C.M. of 16, 20, 25, 45 = 3600

1st number = 3600 × 1 + 3

= 3603 which is not divisible by 21.

2nd number = 3600 × 2 + 3

= 7203 which is divisible by 21.

**48.** **(b)** L.C.M. of 8, 9, 10 = 360

$$\begin{array}{r|l}
360 & 99999\,(277 \\
 & \;\;720 \\ \hline
 & \;\;2799 \\
 & \;\;2520 \\ \hline
 & \;\;\;2799 \\
 & \;\;\;2520 \\ \hline
 & \;\;\;\;279
\end{array}$$

Greatest number of five digits which is divisible by 360 = 99999 − 279 = 99720

∴ Required number = 99729 + 3 = 99723.

**49.** **(d)** H.C.F. of 10857 and 15087 is 141.

The least number of cut pieces

= (10857 + 15087) ÷ 141

= 184.

## Exercise-2
## (Based on Memory)

**2. (d)** Let $x$ be the H.C.F. of two numbers 56 and $k$.
Let $y$ be the L.C.M. of two numbers 56 and $k$.
To find $k$.

$\therefore \quad xy = 56k$

Also $x + y = 680$

$y = 84x$ [Given]

$\Rightarrow \quad 85x = 680 \quad \Rightarrow \quad x = 8$

$\Rightarrow \quad y = 673$

$\Rightarrow \quad 56k = 8 \times 672$

$\Rightarrow \quad k = 96$

$\therefore$ The other number = 96

**3. (a)** L.C.M. of 28, 42 = 84
H.C.F. of 28, 42 = 14

$\therefore$ Required ratio = 84:14 = 6:1.

**4. (c)** Required number = $\dfrac{1820 \times 26}{130}$ = 364.

**5. (c)** Since the H.C.F. is 7 therefore, possible numbers could be 21, 28, 35 and 42. L.C.M. of the numbers does not have the factor of 3. But 21 and 42 are the numbers which have 3 as a factor. So, 21 and 42 will not be the numbers. If 21 and 42 are not the numbers, then the numbers are 28 and 35.

$\therefore$ Sum of the numbers = 28 + 35 = 63.

**6. (b)** $\dfrac{14560 \times 13}{416}$ = 455.

**8. (b)** H.C.F. × L.C.M. = Product of the numbers,
i.e., $16 \times 160 = 32 \times K \quad \Rightarrow \quad K = 80$

**10. (c)** $4 \times 27 \times 3125$
$= 2 \times 2 \times 3 \times 3 \times 3 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$ $8 \times 9 \times 25 \times 7$
$= 2 \times 2 \times 2 \times 3 \times 3 \times 5 \times 5 \times 7$ $16 \times 81 \times 5 \times 11 \times 49$
$= 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3 \times 5 \times 7 \times 7 \times 11$

$\therefore$ H.C.F. $= 2 \times 2 \times 3 \times 3 \times 3 \times 5 = 540$.

**11. (c)** (33, 495); (99, 429); (165, 363); (231, 297)

**12. (b)** $128 \times K = 1920 \times 16 \quad \Rightarrow \quad K = 240$.

**13. (a)** Let the numbers be $x$ and $y$

$\therefore \quad xy = 11 \times 385 = 11 \times 5 \times 7 \times 11 = 77 \times 55$.

**14. (c)** From the given choices we can see that L.C.M. of 1989 and 11 is 21879.
Therefore, required numbers are 1989, 11.

**15. (a)** Let the two numbers be $x$ and $(100 - x)$
L.C.M. × H.C.F. = Product of the numbers
$495 \times 5 = x(100 - x)$
or, $x^2 - 100x + 2475 = 0$
or, $x^2 - 55x - 45x + 2475 = 0$
or, $(x - 55)(x - 45) = 0$ or $x = 45$ or $x = 55$
Thus, the numbers are 45 and 55.
When $x = 55$, we get $100 - x = 45$ and vice versa.
Hence, their difference = 55 – 45 = 10.

**16. (c)** Other number = $\dfrac{225 \times 5}{25}$ = 45.

**17. (d)** Non-multiples of 8 are not the L.C.M.

**18. (c)** Required number = $\dfrac{1820 \times 26}{130}$ = 364.

**19. (c)** Since the H.C.F. is 7 therefore, possible numbers could be 21, 28, 35 and 42. L.C.M. of the numbers does not have the factor of 3. But 21 and 42 are the numbers which have 3 as a factor. So, 21 and 42 will not be the numbers. If 21 and 42 are not the numbers, then the numbers are 28 and 35.

$\therefore$ Sum of the numbers = 28 + 35 = 63.

**20. (a)** Let the two numbers be $x$ and $(100 - x)$.
L.C.M. × H.C.F. = Product of the numbers
$495 \times 5 = x(100 - x)$
or, $x^2 - 100x + 2475 = 0$
or, $x^2 - 55x - 45x + 2475 = 0$
or, $(x - 55)(x - 45) = 0$
or, $x = 45$ or $x = 55$
Thus, the numbers are 45 and 55.
When $x = 55$, we get $100 - x = 45$ and vice versa.
Hence, their difference = 55 – 45 = 10.

**21. (c)** The L.C.M. of 18, 22, 30 is 990.
So, they will meet each other after 990, i.e., 16 minutes and 30 seconds.

**22. (b)** Time taken,

| | |
|---|---|
| 2 | 18, 24, 32 |
| 2 | 9, 12, 16 |
| 2 | 9, 6, 8 |
| 3 | 9, 3, 4 |
| | 3, 1, 4 |

$2 \times 2 \times 2 \times 3 \times 3 \times 4 = 288$ seconds.

**23.** **(b)** $24 = 2 \times 2 \times 2 \times 3$

$36 = 2 \times 2 \times 3 \times 3$

$30 = 2 \times 3 \times 5$

L.C.M. $= 2 \times 2 \times 2 \times 3 \times 3 \times 5 = 360$

Hence, all three friends will meet again after 360 seconds.

i.e., $\frac{360}{60} = 6$ minutes

**24.** **(d)** L.C.M. of 54, 42, 63 = 378 seconds

$$\frac{378}{60} \approx 6.3 \text{ minutes} \approx 6 \text{ minutes}$$

**25.** **(d)** Multiple of two numbers

= Multiple of L.C.M. and H.C.F. of that numbers

$\therefore \quad xy = 3 \times 105$

$$\frac{1}{x}+\frac{1}{y} = \frac{x+y}{xy} = \frac{36}{3\times105}$$

$$= \frac{12}{105} = \frac{4}{35}$$

**26.** **(b)** Number divisible by 20, 28, 32 and 35 is L.C.M. of these numbers

$20 = 4 \times 5$

$28 = 4 \times 7$

$32 = 5 \times 4 \times 2$

$35 = 4 \times 7$

L.C.M. $= 4 \times 5 \times 7 \times 8$

$= 1120$

Required number $= 5834 - 1120 = 4714$

**27.** **(d)** Product of the numbers = H.C.F. × L.C.M.

$\Rightarrow$ Second number $= \frac{8\times48}{24} = 16$

**28.** **(c)** The numbers are 21 and 28.

**29.** **(c)** Let the numbers be $12x$ and $12y$ respectively, where $x$ and $y$ are prime to each other.

Therefore, L.C.M $= 12xy$

so, $12xy = 924$

$\Rightarrow \quad xy = \frac{924}{12} = 77$

Hence, possible pairs are (1, 77) and (7, 11)

**30.** **(c)** L.C.M. of 5, 6, 7, 8 $= 35 \times 24 = 840$

Therefore, the required number $= 840x + 3$, which is exactly divisible by 9.

For $x = 2$, it is divisible by 9.

Hence,

Required number $= 840x + 3$

$= 840 \times 2 + 3$

$= 1683$

**31.** **(d)** Let the number be $10x$, and $10y$, respectively and $x$ and $y$ are prime to each other.

Therefore, L.C.M. $= 10xy$

$\Rightarrow \quad 10xy = 120$

$\Rightarrow \quad xy = \frac{120}{10} = 12$

Possible pairs = (3, 4) or (1, 12)

Hence, sum of the numbers

$= 30 + 40 = 70$

**32.** **(b)** L.C.M. of 24 seconds, 36 seconds and 54 seconds = 216 seconds = 3 min 36 seconds

Required time = 10:18:36 am

**33.** **(d)** Required number = (L.C.M. of 15, 20, 36 and 48) + 3

$$\begin{array}{c|l} 2 & 15, 20, 36, 48 \\ \hline 2 & 15, 10, 18, 24 \\ \hline 3 & 15, 5, 9, 12 \\ \hline 5 & 5, 3, 3, 4 \\ \hline & 1, 1, 3, 4 \end{array}$$

$\therefore$ L.C.M. $= 2\times2\times3\times5\times3\times4 = 720$

$\therefore$ Required number $= 720+3 = 723$

**34.** **(a)** $x^2 + 6x + 8 = x^2 + 4x + 2x + 8$

$= x(x + 4) + 2(x + 4)$

$= (x + 2)(x + 4)$

$x^2 + 3x + 2 = x^2 + 2x + x + 2$

$= x(x + 2) + 1(x + 2)$

$= (x + 2)(x + 1)$

First expression × Second expression = H.C.F. × L.C.M.

$\Rightarrow$ $(x^2 + 3x + 2) \times$ Second expression $= (x^2 + 6x + 8)(x + 1) \times (x + 1)$

$\Rightarrow$ $(x + 2)(x + 1) \times$ Second expression $= (x + 2)(x + 4)(x + 1)(x + 1)$

$\Rightarrow$ Second expression $= \frac{(x+2)(x+4)(x+1)(x+1)}{(x+2)(x+1)}$

$= (x+4)(x+1) = x^2+4x+x+4 = x^2+5x+4$

**35.** **(a)**
$$\begin{array}{c|l} 5 & 625 \\ \hline 5 & 125 \\ \hline 5 & 25 \\ \hline & 5 \end{array}$$

$\therefore$ $625 = 5\times5\times5\times5 = 5^3\times5$

For the smallest cube number, 625 should be divided 5,

$625 \div 5 = 125 = 5^3$

**36.** **(d)** Required number = H.C.F. of 200 and 320 = 40

$$\begin{array}{l} 200)\,320\,(1 \\ \quad \underline{200} \\ \quad 120)\,200\,(1 \\ \qquad \underline{120} \\ \qquad 80)\,120\,(1 \\ \qquad\quad \underline{80} \\ \qquad\quad 40)\,80\,(2 \\ \qquad\qquad \underline{80} \\ \qquad\qquad \times \end{array}$$

**37.** **(b)** L.C.M. of 10, 15 and 20 = 60

Greatest 4-digit number = 9999

$$\therefore\ 60)\,9999\,(166$$
$$\begin{array}{r} \underline{60} \\ 399 \\ \underline{360} \\ 399 \\ \underline{360} \\ 39 \end{array}$$

$\therefore$ Required number = 9999 − 39 = 9960

**38.** **(d)** Required number of students = L.C.M. of 6, 8, 12 and 16 = 48

| | | | | |
|---|---|---|---|---|
| 2 | 6, | 8, | 12, | 16 |
| 2 | 3, | 4, | 6, | 8 |
| 2 | 3, | 2, | 3, | 4 |
| 3 | 3, | 1, | 3, | 2 |
| | 1, | 1, | 1, | 2 |

= 2 × 2 × 2× 2 × 3 = 48

$\therefore$ Required answer = multiple of 48 = 96

**39.** **(d)** If $x = 2$, $y = 4$ then $A = 2$, $B = 4$

$\therefore$ $x + y = A + B$

$\therefore$ $A^3 + B^3 = x^3 + y^3$

**40.** **(c)** Required number = H.C.F. of 411 − 3 = 408; 684 − 4 = 680 and 821 − 5 = 816

H.C.F. of 408 and 816 = 408

H.C.F. of 408 and 680 = 136

$$\begin{array}{l} 408)\,680\,(1 \\ \quad \underline{408} \\ \quad 272)\,408\,(1 \\ \qquad \underline{272} \\ \qquad 136)\,272\,(2 \\ \qquad\quad \underline{272} \\ \qquad\quad \times \end{array}$$

$\therefore$ Required number = 136

**41.** **(b)** L.C.M. of indices of surds = 12

$\therefore$ $\sqrt[3]{4} = \sqrt[12]{4^4} = \sqrt[12]{256}$

$\sqrt{3} = \sqrt[12]{3^6} = \sqrt[12]{729}$

$\sqrt[6]{25} = \sqrt[12]{625}$

$\sqrt[12]{289}$

$\therefore$ The largest number $= \sqrt{3}$ and the smallest number $= \sqrt[3]{4}$

**42.** **(b)** Let the four consecutive prime numbers be $a$, $b$, $c$ and $d$: where $a < b < c < d$.

$\therefore$ $abc = 385$ and $bcd = 1001$

$\therefore$ H.C.F. = $bc$

$$\begin{array}{l} 385)\,1001\,(2 \\ \quad \underline{770} \\ \quad 231)\,385\,(1 \\ \qquad \underline{231} \\ \qquad 154)\,231\,(1 \\ \qquad\quad \underline{154} \\ \qquad\quad 77)\,154\,(2 \\ \qquad\qquad \underline{154} \\ \qquad\qquad \times \end{array}$$

$\therefore$ $bc = 77$

$\therefore$ $bcd = 1001$

$\therefore$ $d = \dfrac{bcd}{bc} = \dfrac{1001}{77} = 13$

**43.** **(b)** H.C.F. of $\dfrac{2}{3}, \dfrac{4}{5}$ and $\dfrac{6}{7}$

$$= \frac{\text{H.C.F. of } 2, 4 \text{ and } 6}{\text{L.C.M. of } 3, 5 \text{ and } 7} = \frac{2}{105}$$

**44.** **(a)** L.C.M. of 3, 6, 9, 12 and 15 = 180 seconds

$\therefore$ Required answer

$$= \frac{36 \times 60}{180} + 1 = 12 + 1 = 13$$

**45.** **(c)** Let the first number be $5x$ and the second number be $6x$

Now, according to the question,

H.C.F. = 4

$\therefore$ $x = 4$

$\Rightarrow$ First number = 5 × 4 = 20

$\Rightarrow$ Second number = 6 × 4 = 24

$\therefore$ Required. L.C.M. = 120

**46.** **(c)** **Quicker Method:**

$\because$ 4 − 2 = 5 − 3 = 6 − 4 = 2

Now, L.C.M. of 4, 5, 6 = 60

$\therefore$ Required number = 60 − difference = 60 − 2 = 58

**47.** **(c)** Let the greatest number be $x$

$\therefore \quad 43 = nx + k \quad \cdots(1)$

$\Rightarrow \quad 91 = mx + k \quad \cdots(2)$

$\Rightarrow \quad 183 - lx + k \quad \cdots(3)$

$\Rightarrow \quad 48 = (m - n)x$

$\Rightarrow \quad 92 = (l - m)x$

$\Rightarrow \quad 140 = (l - n)x$

$\therefore \quad x$ = H.C.F. of 48, 92, and 140 = 4

# Square Root and Cube Root 3

## SQUARE

A number multiplied by itself is known as the *square* of a given number. For example, square of 6 is $6 \times 6 = 36$.

### Square Root

*Square root* of a given number is that number, which, when multiplied by itself is equal to the given number.

For example, square root of 81 is 9, because $9^2 = 9 \times 9 = 81$.

The square root of a number is denoted by the symbol $\surd$ or $\sqrt{\ }$, called *radical sign*.

Thus, $\sqrt{81} = 9$, $\sqrt{64} = 8$ and, so on.

Note, $\sqrt{1} = 1$.

### Methods of Finding a Square Root

**I. Prime Factorization Method**

1. Find the prime factors of a given number.
2. Group the factors in pairs.
3. Take one number from each pair of factors. Multiply them together.

The product thus derived the square root of the given number.

**Illustration 1:** Find the square root of:
(i) 4761 (ii) 207025

**Solution:** (i) $4761 = \underbrace{23 \times 23} \times \underbrace{3 \times 3}$

$\therefore \sqrt{4761} = 23 \times 3 = 69.$

(ii) $207025 = \underbrace{5 \times 5} \times \underbrace{7 \times 7} \times \underbrace{13 \times 13}$

$\therefore \sqrt{207025} = 5 \times 7 \times 13 = 455.$

***Note*:**

The above method is used when a given number is a perfect square or when every prime factor of that number is repeated twice.

**II. Method of Division**

This method is used when the number is large and the factors cannot be easily determined.

The working rule is explained with the help of following example:

**Step 1:** The digits of a number, whose square root is required, are separated into periods of two beginning from the right. The last period may be either single digit or a pair.

$$
\begin{array}{r|l}
 & \quad 476 \\ \hline
8 & \underline{22}\ \ \underline{65}\ \ \underline{76} \\
87 & \underline{16} \\
 & \ \ 665 \\
 & \ \ \underline{609} \\
946 & \quad 5676 \\
 & \quad \underline{5676} \\
 & \quad\ \ \times
\end{array}
$$

**Step 2:** Find a number (here, 4) whose square may be equal to or less than the first period (here, 22).

**Step 3:** Find out the remainder (here, 6) and bring down the next period (here, 65).

**Step 4:** Double the quotient (here, 4) and write to the left (here, 8).

**Step 5:** The divisor of this stage will be equal to the above sum (here, 8) with the quotient of this stage (here, 7) suffixed to it (here, 87).

**Step 6:** Repeat this process (step 4 and step 5) till all the periods get exhausted.

The quotient (here, 476) is equal to the square root of the given number (here, 226576).

**Illustration 2:** Find the square root of:
(i) 180625 (ii) 1498176

**Solution:** (i)

| | |
|---|---|
| | 425 |
| 8 | 18 06 25 |
| 82 | 16 |
| | 206 |
| | 164 |
| 845 | 4225 |
| | 4225 |
| | × |

Thus, $\sqrt{180625} = 425$.

(ii)

| | |
|---|---|
| | 1224 |
| 1 | 1 49 8176 |
| | 1 |
| 22 | 49 |
| | 44 |
| 242 | 581 |
| | 484 |
| 2444 | 9776 |
| | 9776 |
| | × |

Thus, $\sqrt{1478176} = 1224$.

## Square Root of a Decimal

If the given number is having decimal, we separate the digits of that number into periods of two to the right and left beginning from the decimal point and then proceed as in the following illustration:

**Illustration 3:** Find the square root of:
(i) 12.1801 (ii) 127.0129
(iii) 0.1790136 (iv) 0.000625

**Solution:** (i)

| | |
|---|---|
| | 3.49 |
| 3 | 12. 18 01 |
| | 16 |
| 64 | 665 |
| | 609 |
| 689 | 6201 |
| | 6201 |
| | × |

$\therefore \sqrt{12.1801} = 3.49$.

(ii)

| | |
|---|---|
| | 11.27 |
| 1 | 1 27. 01 29 |
| | 1 . |
| 21 | 27 |
| | 21 |
| 222 | 601 |
| | 444 |
| 2447 | 15729 |
| | 15729 |
| | × |

$\therefore \sqrt{127.0129} = 11.27$.

(iii) Since the number of decimal places is odd, we make it even by affixing one 0 to the right.

| | |
|---|---|
| | 0.423 |
| 4 | 0. 17 90 13 60 |
| | 16 |
| 82 | 190 |
| | 164 |
| 843 | 2613 |
| | 2529 |
| 846 | 8460 |

In the given solution, after bringing down the last period, we note that the remainder is not zero. So, a pair of zeros can be annexed and the process can be continued to find the square root up to 4 places of decimals. The given process can be continued still further and square root up to the required number of decimal places can be obtained.

***Note***:

If a decimal has an odd number of decimal places, its square root cannot be correctly found.

(iv)

| | |
|---|---|
| | .025 |
| | 0. 00 06 25 |
| | 00 |
| 02 | 06 |
| | 04 |
| 45 | 225 |
| | 225 |
| | × |

$\therefore \sqrt{0.000625} = 0.025$.

## Square Root of a Fraction

(a) *If the denominator is a perfect square*:
The square root is found by taking the square root of the numerator and denominator separately.

(b) *If the denominator is not a perfect square*:
The fraction is converted into decimal. Then square root is obtained or the denominator is made perfect square by multiplying and dividing by a suitable number. Thus, its square root is obtained.

**Illustration 4:** Find the square root of:

(i) $\frac{2704}{49}$ (ii) $\frac{44}{25}$

(iii) $\frac{354}{43}$ (iv) $\frac{461}{32}$

**Solution:** (i) $\sqrt{\frac{2704}{49}} = \frac{\sqrt{2704}}{\sqrt{49}} = \frac{\sqrt{52 \times 52}}{\sqrt{7 \times 7}} = \frac{52}{7}$

$= 7\frac{3}{7}$.

(ii) $\sqrt{\dfrac{44}{25}} = \dfrac{\sqrt{44}}{\sqrt{25}} = \dfrac{\sqrt{44}}{\sqrt{5\times5}} = \dfrac{\sqrt{44}}{5} = \dfrac{6.6332}{5}$

$= 1.3266$ (nearly).

(iii) $\sqrt{\dfrac{354}{43}} = \sqrt{8.2325} = 2.8692$ (nearly)

(iv) $\sqrt{\dfrac{461}{32}} = \sqrt{\dfrac{461\times2}{32\times2}} = \dfrac{\sqrt{922}}{\sqrt{64}} = \dfrac{30.3644}{8}$

$= 3.7955$ (nearly).

## Cube

*Cube* of a number is obtained by multiplying the number itself thrice.

For example, 27 is the cube of 3 as $27 = 3 \times 3 \times 3$.

## Cube Root

The *cube root* of a given number is that number, which, when raised to the third power, produces the given number, that is, the cube root of a number $x$ is the number whose cube is $x$.

The cube root of $x$ is written as $\sqrt[3]{x}$ .

For example, cube root of 64 is 4 as $4 \times 4 \times 4 = 64$.

## Methods to Find Cube Root

**I. Method of Factorization**

1. Write the given number as product of prime factors.
2. Take the product of prime numbers, choosing one out of three of each type.

This product gives the cube root of the given number.

**Illustration 5:** Find the cube root of 42875.

**Solution:** Resolving 42875 into prime factors, we get

$$42875 = \underbrace{5\times5\times5}\times\underbrace{7\times7\times7}$$

$$\therefore \quad \sqrt[3]{42875} = 5 \times 7 = 35$$

**II. Short-cut Method to Find Cube Roots of Exact Cubes Consisting of up to 6 Digits:** Before we discuss the method to find the cube roots of exact cubes, the following two remarks are useful and must be keep in mind.

1. $1^3 = 1$; $2^3 = 8$; $3^3 = 27$; $4^3 = 64$; $5^3 = 125$; $6^3 = 216$; $7^3 = 343$; $8^3 = 512$; $9^3 = 729$; $10^3 = 1000$.
2. If the cube ends in 1, then its cube root ends in 1.

If the cube ends in 2, then its cube root ends in 8
If the cube ends in 3, then its cube root ends in 7
If the cube ends in 4, then its cube root ends in 4
If the cube ends in 5, then its cube root ends in 5
If the cube ends in 6, then its cube root ends in 6
If the cube ends in 7, then its cube root ends in 3
If the cube ends in 8, then its cube root ends in 2
If the cube ends in 9, then it cube root ends in 9
If the cube ends in 0, then its cube root ends in 0

**Clearly, from the given:**

$1 \leftrightarrow 1$, $4 \leftrightarrow 4$, $5 \leftrightarrow 5$, $6 \leftrightarrow 6$, $9 \leftrightarrow 9$, $0 \leftrightarrow 0$
$2 \leftrightarrow 8$, $3 \leftrightarrow 7$.

The method of finding the cube root of a number up to 6 digits, which is actually a cube of some number consisting of 2 digits, is best illustrated with the help of the following examples.

**Illustration 6:** Find the cube roots of the following.

(i) 2744 (ii) 9261
(iii) 19684 (iv) 54872
(v) 614125

**Solution**

(i) Make groups of 3 digits from the right side. <u>2</u> <u>744</u>
2 lies between $1^3$ and $2^3$, so the left digit is 1.
744 ends in 4, so the right digit is 4.
Thus, cube root of 2744 is 14.

(ii) <u>9</u> <u>261</u>
9 lies between $2^3$ and $3^3$, so left digit is 2.
261 ends in 1, so right digit is 1.
Thus, cube root of 9261 is 21.

(iii) 19 683
19 lies between $2^3$ and $3^3$, so the left digit is 2.
683 ends in 3, so the right digit is 7.
Thus, cube root of 19683 is 27.

(iv) <u>54</u> <u>872</u>
54 lies between $3^3$ and $4^3$, so the left digit is 3.
872 ends in 2, so the right digit is 8.
Thus, cwube root of 19683 is 38.

(iv) <u>614</u> <u>125</u>
614 lies between $8^3$ and $9^3$, so the left digit is 8.
125 ends in 5, so the right digit is 5.
Thus, cube root of 614125 is 85.

## EXERCISE-I

1. Find the square root of 4356.
(a) 68 (b) 64
(c) 66 (d) None of these

2. Find the square root of 104976.
(a) 324 (b) 424
(c) 326 (d) None of these

3. Find the square root of 211600.
(a) 460 (b) 440
(c) 480 (d) None of these

4. Find the value of $\sqrt{6492304}$.
(a) 2384 (b) 2484
(c) 2548 (d) 2684

5. Find the least number, which, when multiplied with 74088 will make it a perfect square.
(a) 42 (b) 44
(c) 46 (d) 48

6. $\sqrt{10} \times \sqrt{250} = ?$
(a) 46.95 (b) 43.75
(c) 50.25 (d) 50.00

7. $\sqrt{80} + 3\sqrt{245} - \sqrt{125} = ?$
(a) $20\sqrt{5}$ (b) $25\sqrt{2}$
(c) $15\sqrt{2}$ (d) None of these

8. $\dfrac{250}{\sqrt{?}} = 10$
(a) 25 (b) 250
(c) 625 (d) 2500

9. If $\sqrt{256}\sqrt{\sqrt{x}} = 2$, then $x$ is equal to:
(a) 64 (b) 128
(c) 512 (d) 1024

10. Find the smallest number by which 216 should be divided to make the result a perfect square.
(a) 4 (b) 3
(c) 6 (d) 2

11. $\dfrac{\sqrt{?}}{200} = 0.02$
(a) 0.4 (b) 4
(c) 16 (d) 1.6

12. $\dfrac{\sqrt{6727}}{\sqrt{7}} = ?$
(a) 30.79 (b) 32.29
(c) 31 (d) None of these

13. $\sqrt{.09} = ?$
(a) 0.3 (b) 0.03
(c) 0.003 (d) None of these

14. $\dfrac{14}{3+\sqrt{2}} = ?$
(a) 3.172 (b) 4.586
(c) 8.828 (d) None of these

15. Find the smallest number, which, when added to 3579 gives a perfect square.
(a) 27 (b) 24
(c) 21 (d) 18

16. If $\sqrt{\left(1+\dfrac{27}{169}\right)} = 1+\dfrac{x}{13}$, then $\boldsymbol{x}$ equals:
(a) 1 (b) 3
(c) 5 (d) 7

17. $\dfrac{\sqrt{4375}}{\sqrt{7}} = ?$
(a) 24.75 (b) 27.75
(c) 25 (d) 35

18. If $\sqrt{0.04 \times 0.4 \times a} = 0.4 \times 0.04 \times \sqrt{b}$, then the value of $\dfrac{a}{b}$ is:
(a) 0.016 (b) 1.60
(c) 0.16 (d) None of these

19. $\sqrt{\sqrt[3]{\sqrt[3]{\sqrt[3]{\sqrt[3]{\sqrt[3]{3}}}}}} = ?$
(a) $3^{31/64}$ (b) $3^{31/32}$
(c) $3^{1/64}$ (d) None of these

20. $\dfrac{\sqrt{1296}}{?} = \dfrac{?}{2.25}$
(a) 6 (b) 7
(c) 8 (d) 9

21. $\sqrt{176 + \sqrt{2401}} = ?$
(a) 14 (b) 15
(c) 18 (d) 24

22. $\sqrt{10} \times \sqrt{15} = ?$
(a) $5\sqrt{6}$ (b) $6\sqrt{5}$
(c) 5 (d) $\sqrt{30}$

**23.** $\sqrt{\frac{4}{3}} - \sqrt{\frac{3}{4}} = ?$

(a) $\frac{1}{2\sqrt{3}}$ (b) $-\frac{1}{2\sqrt{3}}$

(c) 1 (d) $\frac{5\sqrt{3}}{6}$

**24.** $\sqrt{248+\sqrt{52+\sqrt{144}}} = 1$

(a) 14 (b) 16

(c) 16.6 (d) 18.8

**25.** $\sqrt{0.0009} \surd \sqrt{0.01} = ?$

(a) 3 (b) 0.3

(c) $\frac{1}{3}$ (d) None of these

**26.** $\frac{1}{\sqrt{9}-\sqrt{8}} = ?$

(a) $\frac{1}{2}(3-2\sqrt{2})$

(b) $\frac{1}{3+2\sqrt{2}}$

(c) $3-2\sqrt{2}$

(d) $3+2\sqrt{2}$

**27.** If $\sqrt{\frac{x}{169}} = \frac{54}{39}$, then $x$ is equal to:

(a) 108 (b) 324

(c) 2916 (d) 4800

**28.** $\sqrt{12+\sqrt{12+\sqrt{12+\cdots}}} = ?$

(a) 3 (b) 4

(c) 6 (d) Greater than 6

**29.** $\frac{112}{\sqrt{196}} \times \frac{\sqrt{576}}{12} \times \frac{\sqrt{256}}{8} = ?$

(a) 8 (b) 12

(c) 16 (d) 32

**30.** If $\sqrt{12} = 3.464$, value of $\sqrt{\frac{3}{4}} + 2\sqrt{\frac{4}{3}}$ is:

(a) 3.17 (b) 3.464

(c) 3.1753 (d) None of these.

**31.** If $\sqrt{15625} = 125$, then the value of:

$\sqrt{15625}+\sqrt{156.25}+\sqrt{1.5625}$, is

(a) 1.3875 (b) 13.875

(c) 138.75 (d) 156.25

**32.** If $\sqrt{0.03\times0.3\times a} = 0.03\times0.3\times\sqrt{b}$, the value of $\frac{a}{b}$, is:

(a) 0.009 (b) 0.03

(c) 0.09 (d) None of these

**33.** Given that $\sqrt{4096} = 64$, the value of $\sqrt{4096}+\sqrt{4096}+\sqrt{.004096}$, is:

(a) 70.4 (b) 70.464

(c) 71.104 (d) 71.4

**34.** If $\sqrt{1+\sqrt{1-\frac{2176}{2401}}} = 1+\frac{x}{7}$, the value of $x$ is:

(a) 3 (b) 1

(c) 5 (d) 7

**35.** Which of the following numbers, wherein some of the digits have been suppressed by symbols, can possibly be the perfect square of a 3 digit odd number?

(a) 65 ××× 1 (b) 9 ×× 1

(c) 10 ××× 4 (d) 9 ×××××× 5

**36.** $\sqrt{\frac{0.324\times0.081\times4.624}{1.5625\times0.0289\times72.9\times64}} = ?$

(a) 24 (b) 2.40

(c) 0.024 (d) None of these

**37.** Find the cube root of $\frac{512}{3375}$.

(a) 12/15 (b) 16/25

(c) 8/15 (d) None of these

**38.** $\sqrt{0.01+\sqrt{0.0064}} = ?$

(a) 0.3 (b) 0.03

(c) $\sqrt{0.18}$ (d) None of these

**39.** Find the cube root of 15.625.

(a) 3.5 (b) 2.5

(c) 4.5 (d) 5.5

**40.** What is the value of $\sqrt[3]{.000064}$?

(a) 0.4 (b) 0.08

(c) 0.04 (d) 0.16

**41.** What is the value of $\sqrt[3]{\sqrt{441}+\sqrt{16}+\sqrt{4}}$

(a) 3 (b) 5

(c) 7 (d) 9

**42.** The least number by which 14175 be divided to make it a perfect square is:

(a) 3 (b) 5

(c) 7 (d) 15

**43.** $\frac{\sqrt{5}-\sqrt{3}}{\sqrt{5}+\sqrt{3}}$ is equal to:

(a) $4+\sqrt{15}$ (b) $4-\sqrt{15}$

(c) $\frac{1}{2}$ (d) 1

**44.** $\dfrac{\sqrt{24}+\sqrt{216}}{\sqrt{96}} = ?$

(a) $2\sqrt{6}$ (b) $6\sqrt{2}$

(c) 2 (d) $\dfrac{2}{\sqrt{6}}$

**45.** Given that $\sqrt{20} = 4.472$, find the square root of $2\dfrac{2}{9}$ up to two places of decimals.

(a) 1.56 (b) 1.69

(c) 1.49 (d) None of these

**46.** If $a = \dfrac{\sqrt{5}+1}{\sqrt{5}-1}$ and $b = \dfrac{\sqrt{5}-1}{\sqrt{5}+1}$, then the value of $\dfrac{a^2+ab+b^2}{a^2-ab+b^2}$ is:

(a) $\dfrac{3}{4}$ (b) $\dfrac{4}{3}$

(c) $\dfrac{3}{5}$ (d) $\dfrac{5}{3}$

**47.** The least number by which 10584 be multiplied to make it a perfect square is:

(a) 2 (b) 3

(c) 6 (d) 8

**48.** The smallest number which is a perfect square and contains 7936 as a factor is:

(a) 12008 (b) 246016

(c) 61504 (d) 240616

**49.** $\sqrt{0.00059049} = ?$

(a) 0.243 (b) 0.0243

(c) 0.00243 (d) 0.000243

**50.** Given that $\sqrt{10} = 3.16$, what is the value of $\sqrt{\dfrac{4}{12.1}}$ to one place of decimal?

(a) 0.16 (b) 0.06

(c) 0.6 (d) 0.016

**51.** $\sqrt{\dfrac{0.256\times0.081\times4.356}{1.5625\times0.0121\times129.6\times64}} = ?$

(a) 0.0124 (b) 0.124

(c) 0.0024 (d) 0.024

**52.** A general wishing to draw up his 16160 men in the form of a solid square found that he had 31 men over. The number of men in the front row is:

(a) 127 (b) 123

(c) 137 (d) 129

**53.** The areas of two square fields are 420.25 $m^2$ and 441 $m^2$, respectively. The ratio of their sides is:

(a) 20:21 (b) 40:41

(c) 41:42 (d) 40:42

**54.** A General wishing to draw up his 5180 men in the form of a solid square found that he had 4 men less. If he could get four more men and form the solid square, the number of men in the front row is:

(a) 68 (b) 72

(c) 78 (d) 82

**55.** The largest number of three digits which is a perfect square is:

(a) 900 (b) 841

(c) 961 (c) 784

**56.** What least number should be subtracted from the square root of $21\dfrac{15}{289}$ so that the result is a whole number?

(a) 15/289 (b) 7/17

(c) 10/17 (d) 5/17

**57.** The smallest number which when subtracted from the number 62512 makes it a perfect square is:

(a) 22 (b) 32

(c) 12 (d) 2

**58.** The largest number of five digits which is a perfect square is:

(a) 97344 (b) 98596

(c) 99856 (d) None of these

**59.** By what least number, 2450 be multiplied, so that the resulting number is perfect square?

(a) 8 (b) 10

(c) 5 (d) 2

**60.** The smallest number by which 3600 must be multiplied to make it a perfect cube is:

(a) 40 (b) 60

(c) 20 (d) 15

## Exercise-2
## (Based on Memory)

**1.** If $\sqrt{4096} = 64$, then the value of $\sqrt{40.96}+\sqrt{0.4096}+\sqrt{0.004096}+\sqrt{0.00004096}$ up to two decimal places is:

(a) 7.09 (b) 7.10
(c) 7.11 (d) 7.12

**[SSC (GL) Prel. Examination, 2005]**

**2.** $\sqrt[3]{19683} = ? \times 3$

(a) 90 (b) 27
(c) 3 (d) 18
(e) None of these

**[Corporation Bank, PO Examination, 2006]**

**3.** $\sqrt{\sqrt{1024}+\sqrt{7921}} \times 48.5 = ?$

(a) 586.5 (b) 423.5
(c) 348.5 (d) 521.5
(e) None of these

**[Corporation Bank, PO Examination, 2006]**

**4.** $\sqrt{\sqrt{2500}+\sqrt{961}} = (?)^2$

(a) 81 (b) 3
(c) 6561 (d) 9
(e) None of these

**[Central Bank of India, PO Examination, 2006]**

**5.** The digit in the unit's place in the cube root of 21952 is:

(a) 8 (b) 6
(c) 4 (d) 2

**[SSC (GL) Prel. Examination, 2000]**

**6.** Given $\sqrt{5}$ = 2.2361, $\sqrt{3}$ = 1.7321, then $\frac{1}{\sqrt{5}-\sqrt{3}}$ is equal to:

(a) 1.984 (b) 1.9841
(c) 1.98 (d) 2

**[SSC (GL) Prel. Examination, 2000]**

**7.** $\frac{\sqrt{625}}{11} \times \frac{14}{\sqrt{25}} \times \frac{11}{\sqrt{196}}$ is equal to:

(a) 15 (b) 5
(c) 0.5 (d) 1.5

**[SSC (GL) Prel. Examination, 2000]**

**8.** The square root of $(272^2 - 128^2)$ is:

(a) 256 (b) 200
(c) 240 (d) 144

**[SSC (GL) Prel. Examination, 2000]**

**9.** The square root of 0.9 is equal to:

(a) 0.3 (b) 0.03
(c) 0.94 (d) 0.81

**[SSC (GL) Prel. Examination, 2000]**

**10.** The value of $\frac{\sqrt{0.441}}{\sqrt{0.625}}$ is equal to:

(a) 0.048 (b) 0.84
(c) 0.48 (d) 0.084

**[SSC (GL) Prel. Examination, 2002]**

**11.** The square root of $\frac{0.342 \times 0.684}{0.000342 \times 0.000171}$ is:

(a) 250 (b) 2500
(c) 2000 (d) 4000

**[SSC (GL) Prel. Examination, 2002]**

**12.** The sum of $\sqrt{0.01}+\sqrt{0.81}+\sqrt{1.21}+\sqrt{0.0009}$ is:

(a) 2.1 (b) 2.13
(c) 2.03 (d) 2.11

**13.** If cube root of 175616 is 56, then the value of $\sqrt[3]{175.616}$ + $\sqrt[3]{0.175616}$ + $\sqrt[3]{0.000175616}$ is equal to:

(a) 0.168 (b) 62.16
(c) 6.216 (d) 6.116

**[SSC (GL) Prel. Examination, 2002]**

**14.** Given $\sqrt{2}$ = 1.414, then the value of $\sqrt{8}$ + $\sqrt[2]{32}$ – $\sqrt[3]{128}$ + $\sqrt[4]{50}$ is:

(a) 8.484 (b) 8.526
(c) 8.426 (d) 8.876

**[SSC (GL) Prel. Examination, 2003]**

**15.** $\sqrt{\sqrt[3]{0.004096}}$ is equal to:

(a) 4 (b) 0.4
(c) 0.04 (d) 0.004

**[SSC (GL) Prel. Examination, 2003]**

**16.** If $\sqrt{15}$ = 3.88, then what is the value of $\sqrt{\frac{5}{3}}$ ?

(a) $1.29\overline{3}$ (b) 1.2934
(c) 1.29 (d) 1.295

**[SSC (GL) Prel. Examination, 2003]**

**17.** If the square root of 5625 is 75, then $\sqrt{5625}+\sqrt{56.25}+\sqrt{?}=$

(a) 9 (b) 83.25
(c) 82.80 (d) 8.325

**[SSC (GL) Prel. Examination, 2002]**

**18.** What approximate value should come in place of the question mark (?) ?

$36.0001 \div 5.9998 \times \sqrt{?} = 108.0005$

(a) 18 (b) 16
(c) 256 (d) 316
(e) 325

**[Bank of Maharashtra PO Examination, 2003]**

**19.** $\sqrt{1223.9975} = ?$

(a) 110 (b) 144
(c) 34 (d) 12.55
(e) 125

**[IBPS Jr. Executive Examination, 2002]**

**20.** $\sqrt{\sqrt{20800}} = ?$

(a) 12 (b) 120
(c) 140 (d) 102
(e) 1020

**[IBPS Jr. Executive Examination, 2002]**

**21.** $\sqrt{10000}+\dfrac{3.001}{4.987}$ of $1891.992 = ?$

(a) 2500 (b) 1230
(c) 1640 (d) 1525
(e) 2130

**[Canara Bank PO, 2003]**

**22.** $\sqrt{?} = \pm\ 75$

(a) –562.5 (b) $75 \times -75$
(c) 1500 (d) Cannot be determined
(e) None of these

**[NABARD Assistant Manager Examination, 2002]**

**23.** $(1.5)^2 \times \sqrt{0.0225} = ?$

(a) 0.3375 (b) 3.275
(c) 32.75 (d) 0.0373
(e) None of these

**[Andhra Bank Specialist Officer's Examination, 2002]**

**24.** $\left(\dfrac{8}{125}\right)^{-4/3}$ simplifies to:

(a) $\dfrac{625}{16}$ (b) $\dfrac{625}{8}$

(c) $\dfrac{625}{32}$ (d) $\dfrac{16}{625}$

**[SSC (GL) Prel. Examination, 2000]**

**25.** $\left(\dfrac{1+\sqrt{2}}{\sqrt{5}+\sqrt{3}}+\dfrac{1-\sqrt{2}}{\sqrt{5}-\sqrt{3}}\right)$ simplifies to:

(a) $\sqrt{5}+\sqrt{6}$ (b) $2\sqrt{5}+\sqrt{6}$
(c) $\sqrt{5}-\sqrt{6}$ (d) $2\sqrt{5}-3\sqrt{6}$

**[SSC (GL) Prel. Examination, 2000]**

**26.** If $x = 7 - 4\sqrt{3}$, then the value of $x+\dfrac{1}{x}$ is:

(a) $3\sqrt{3}$ (b) $8\sqrt{3}$
(c) $14 + 8\sqrt{3}$ (d) 14

**[SSC (GL) Prel. Examination, 2000]**

**27.** $7^{1/4} \times (343)^{0.25}$ is equal to:

(a) $\sqrt{\phantom{7}}$ (b) 49
(c) 7 (d) $7\sqrt{7}$

**[SSC (GL) Prel. Examination, 2000]**

**28.** One less then $(49)^{15}$ is exactly divisible by:

(a) 50 (b) 51
(c) 14 (d) 8

**[SSC (GL) Prel. Examination, 2000]**

**29.** The value of $\left(1+\dfrac{1}{x}\right)\left(1+\dfrac{1}{x+1}\right)\left(1+\dfrac{1}{x+2}\right)\left(1+\dfrac{1}{x+3}\right)$ is:

(a) $1+\dfrac{1}{x+4}$ (b) $x + 4$

(c) $\dfrac{1}{x}$ (d) $\dfrac{x+4}{x}$

**[SSC (GL) Prel. Examination, 2000]**

**30.** When $\left(\dfrac{1}{2}-\dfrac{1}{4}+\dfrac{1}{5}-\dfrac{1}{6}\right)$ is divided by $\dfrac{2}{5}-\dfrac{5}{9}+\dfrac{3}{5}-\dfrac{7}{18}$, the result is:

(a) $5\dfrac{1}{10}$ (b) $2\dfrac{1}{18}$

(c) $3\dfrac{1}{6}$ (d) $3\dfrac{3}{10}$

**[SSC (GL) Prel. Examination, 2000]**

**31.** $\left(\dfrac{\sqrt{5}+\sqrt{3}}{\sqrt{5}-\sqrt{3}}\right)^2+\left(\dfrac{\sqrt{5}-\sqrt{3}}{\sqrt{5}+\sqrt{3}}\right)^2$ is equal to:

(a) 64 (b) 62
(c) 66 (d) 68

**[SSC (GL) Prel. Examination, 2000]**

**32.** If $25^{25}$ is divisible by 26, the remainder is:

(a) 1 (b) 2
(c) 24 (d) 25

**[SSC (GL) Prel. Examination, 2000]**

**33.** $\sqrt{6+\sqrt{6+\sqrt{6+\cdots}}}$

(a) $6^{2/3}$ (b) 6
(c) $3^{1/3}$ (d) 3

**[SSC (GL) Prel. Examination, 2000]**

**34.** $(16)^{0.16} \times (16)^{0.04} \times (2)^{0.2}$ is equal to:

(a) 1 (b) 2
(c) 4 (d) 16

**[SSC (GL) Prel. Examination, 2000]**

**35.** A number when divided by 68 gives the quotient 269 and remainder zero. If the same number is divided by 67, the remainder is:

(a) 0 (b) 1
(c) 2 (d) 3

**[SSC (GL) Prel. Examination, 2000]**

**36.** Find the value of * in the following:

$$1\frac{2}{3}+\frac{2}{7}\times\frac{*}{7}=1\frac{1}{4}\times\frac{2}{3}\div\frac{1}{6}$$

(a) $\frac{1}{6}$ (b) 0.6
(c) 0.006 (d) 6

**[SSC (GL) Prel. Examination, 2002]**

**37.** A certain amount of money is distributed among A, B and C. A gets $\frac{3}{16}$ and B gets $\frac{1}{4}$ of the whole amount. If C gets ₹.81, then *B* gets:

(a) ₹30 (b) ₹36
(c) ₹32 (d) ₹40

**[SSC (GL) Prel. Examination, 2002]**

**38.** If * means adding 6 times the second number to the first number, then (1 * 2) * 3 equals:

(a) 121 (b) 31
(c) 93 (d) 91

**[SSC (GL) Prel. Examination, 2003]**

**39.** Find the value of $\dfrac{2}{1+\dfrac{1}{1-\dfrac{1}{2}}}\times\dfrac{3}{\dfrac{5}{6}\text{of}\dfrac{3}{2}\div 1\dfrac{1}{4}}$

(a) 6 (b) 8
(c) 4 (d) 2

**[SSC (GL) Prel. Examination, 2003]**

**40.** A man spends $\frac{1}{3}$ of his income on food, $\frac{2}{5}$ of his income on house rent and $\frac{1}{5}$ of his income on clothes. If he still has ₹400 left with him, his income is:

(a) ₹4000 (b) ₹5000
(c) ₹6000 (d) ₹7000

**[SSC (GL) Prel. Examination, 2003]**

**41.** If $a * b = 2a + 3b$, then the value of 2 * 3 + 3 * 4 is:

(a) 24 (b) 31
(c) 32 (d) 34

**[SSC (GL) Prel. Examination, 2002]**

**42.** The simplified value of $\left[\sqrt[3]{\sqrt[6]{2^9}}\right]^4 \times \left[\sqrt[6]{\sqrt[3]{2^9}}\right]^4$ is:

(a) $2^{16}$ (b) $2^{12}$
(c) $2^8$ (d) $2^4$

**[SBI PO Examination, 2000]**

**43.** The value of the following is:

$$\sqrt{10+\sqrt{25+\sqrt{108+\sqrt{154+\sqrt{225}}}}}$$

(a) 10 (b) 8
(c) 6 (d) 4

**[Bank of Baroda PO, 1999]**

**44.** $\frac{2}{5}$ of $\frac{1}{3}$ for $\frac{3}{7}$ of a number is 15. What is 40 per cent of that number?

(a) 136 (b) 140
(c) 72 (d) None of these

**[IBPS Jr. Executive Examination, 2002]**

**45.** By how much is $\frac{2}{5}$ of 200 greater than $\frac{3}{5}$ of 125?

(a) 15 (b) 3
(c) 5 (d) 30

**[Canara Bank PO, 2003]**

**46.** Which of the following has fractions in ascending order?

(a) $\frac{2}{3},\frac{3}{5},\frac{7}{9},\frac{9}{11},\frac{8}{9}$ (b) $\frac{3}{5},\frac{2}{3},\frac{7}{9},\frac{9}{11},\frac{8}{9}$
(c) $\frac{8}{9},\frac{9}{11},\frac{7}{9},\frac{3}{5},\frac{2}{3}$ (d) $\frac{3}{5},\frac{2}{3},\frac{9}{11},\frac{7}{9},\frac{8}{9}$

**[NABARD Asst. Manager Examination, 2002]**

**47.** What should come in place of the question mark (?) in the following equation

$$47^{7.5} \div 47^{3/2} \times 47^{-3} = \left(\sqrt{47}\right)^{?}$$

(a) 3 (b) $2\frac{1}{2}$
(c) 6 (d) 3.5

**[BSRB Patana PO, 2001]**

**48.** $\frac{(10008.99)^2}{10009.001} \times \sqrt{3589} \times 0.4987 = ?$

(a) 3000 (b) 300000
(c) 3000000 (d) 5000

**[BSRB Bhopal PO, 2000]**

**49.** Multiply the difference between the two lowest numbers with the difference between the two highest numbers in the following sequences:

89, 7, 91, 72, 31, 25, 18, 89, 16, 58, 38, 42, 86

(a) 18 (b) 77
(c) 81 (d) 16

**[NABARD, 1999]**

**50.** $\frac{1}{5}$ of a number is equal to $\frac{5}{8}$ of the second number. If 35 is added to the first number it becomes four times of second number. What is the value of the second number?

(a) 125 (b) 70
(c) 40 (d) 25

**[NABARD, 1999]**

**51.** $9^3 \times 81^2 \div 27^3 = (3)^?$

(a) 3 (b) 4
(c) 5 (d) 6

**[Punjab and Sind Bank PO, 2010]**

**52.** $(35)^2 \div \sqrt[3]{125} + (25)^2 \div 125 = ?$

(a) 200 (b) 250
(c) 150 (d) 100

**[Punjab National Bank PO, 2010]**

**53.** $(?)^2 \times (12)^2 \div (48)^2 = 81$

(a) 26 (b) 32
(c) 9 (d) None of these

**[Punjab National Bank PO, 2010]**

**54.** $\sqrt{1225} = ?$

(a) 25 (b) 45
(c) 55 (d) None of these

**[Haryana Grameen Bank PO, 2009]**

**55.** Which number should replace both the question marks in the following equation

$$\frac{?}{49} = \frac{16}{?}$$

(a) 48 (b) 18
(c) 38 (d) 28

**[Haryana Grameen Bank PO, 2009]**

**56.** $\sqrt{898} \times (12.005)^2 + ? = 5000$

(a) 680 (b) 720
(c) 750 (d) 620

**[RBI (Grade 'B') PO, 2009]**

**57.** $\sqrt{\sqrt{44944} + \sqrt{52441}} = ?$

(a) 312 (b) 441
(c) 485 (d) None of these

**[Andhra Bank PO, 2008]**

**58.** Which number should replace both the question marks in the following equation?

$$\frac{?}{171} = \frac{76}{?}$$

(a) 114 (b) 116
(c) 57 (d) 176

**[Andhra Bank PO, 2008]**

**59.** $(72)^2 + (61)^2 = (199)^2 - (?) - 420$

(a) 165 (b) 198
(c) 182 (d) 174

**[Uttrakhand GBO PO, 2007]**

**60.** Which number should replace both the question marks in the following equation?

$$\frac{?}{944} = \frac{59}{?}$$

(a) 218 (b) 236
(c) 244 (d) 264

**[Uttrakhand GBO PO, 2007]**

**61.** $\sqrt[3]{4663} + 349 = ? \div 21.003$

(a) 7600 (b) 7650
(c) 7860 (d) 7680

**[IBPS Bank PO, 2011]**

**62.** $\sqrt{6354} \times 34.993 = ?$

(a) 3000 (b) 2800
(c) 2500 (d) 3300

**[IBPS Bank PO, 2011]**

**63.** $\sqrt[3]{1331} = ?$

(a) 27 (b) 21
(c) 17 (d) None of these

**[OBC PO Examination, 2009]**

**64.** $\sqrt{24^4} + 224 = ? \times 20^2$

(a) 20 (b) 4
(c) 2 (d) 16

**[United Bank of India PO Examination, 2009]**

**65.** Which number should replace both the question marks (?) in the following equation?

$$\frac{?}{576} = \frac{256}{?}$$

(a) 384 (b) 398
(c) 404 (d) 416

**[IOB PO Examination, 2009]**

**66.** Which number should replace both the question marks in the following equation?

$$\frac{?}{432} = \frac{243}{?}$$

(a) 308 (b) 312
(c) 324 (d) 316

**[SBI PO Examination, 2008]**

**67.** What is the least number that can be added to the number 1020 to make it a perfect square?

(a) 65 (b) 12
(c) 59 (d) 4

**[Indian Bank PO Examination, 2011]**

**68.** $(?)^3 = 4913$

(a) 27 (b) 19
(c) 17 (d) 29

**[Indian Bank PO, 2011]**

**69.** $348 \div 29 \times 15 + 156 = (?)^3 + 120$

(a) 12 (b) 6
(c) 36 (d) 9

**[Corporation Bank PO Examination, 2011]**

**70.** $(4 \times 4)^3 \div (512 \div 8)^4 \times (32 \times 8)^4 = (2 \times 2)^{? + 4}$

(a) 8 (b) 12
(c) 6 (d) 14

**[Corporation Bank PO Examination, 2011]**

**71.** $\left(2\sqrt{392} - 21\right) + \left(\sqrt{8} - 7\right)^2 = (?)^2$

(a) 4 (b) – 4
(c) 12 (d) 6

**[Corporation Bank PO Examination, 2011]**

**72.** $(\sqrt{8} \times \sqrt{8})^{1/2} + (9)^{1/2} = (?)^3 + \sqrt{8} - 340$

(a) 7 (b) 19
(c) 18 (d) 9

**[Bank of Baroda PO Examination, 2011]**

**73.** Sum of square of the first number and cube of the second number is 568 together. Also square of the second number is 15 less than the square of 8. What is the value of $\frac{3}{5}$ of the first number? (assuming both the numbers are positive)

(a) 18 (b) 8
(c) 9 (d) 16

**[Bank of Baroda PO Examination, 2011]**

**74.** $(?)^3 = 729$

(a) 14 (b) 7
(c) 19 (d) None of these.

**[Bank of India PO Examination, 2010]**

**75.** $\sqrt{2809} = ?$

(a) 43 (b) 47
(c) 57 (d) 53

**[IDBI PO Examination, 2009]**

**76.** The expression $(2+\sqrt{2}) + \frac{1}{(2+\sqrt{2})} + \frac{1}{(2-\sqrt{2})}$ equals:

(a) $4+\sqrt{2}$ (b) $2\sqrt{2}$
(c) $4-\sqrt{2}$ (d) $2+\sqrt{2}$

**[UPPCS Examination, 2012]**

**77.** The square root of 0.09 is:

(a) 0.30 (b) 0.03
(c) 0.81 (d) 0.081

**[SSC (GL) Examination, 2010]**

**78.** If $\sqrt{1+\frac{x}{961}} = \frac{32}{31}$, then the value of $x$ is:

(a) 63 (b) 61
(c) 65 (d) 64

**[SSC (GL) Examination, 2011]**

**79.** If $\sqrt{1+\frac{x}{9}} = \frac{13}{3}$, then the value of $x$ is:

(a) $\frac{1439}{9}$ (b) 160
(c) $\frac{1443}{9}$ (d) 169

**[SSC (GL) Examination, 2011]**

**80.** If $\frac{4\sqrt{3}+5\sqrt{2}}{\sqrt{48}+\sqrt{18}} = a + b\sqrt{6}$, then the values of $a$ and $b$ are, respectively:

(a) $\frac{9}{5}, \frac{4}{15}$ (b) $\frac{3}{11}, \frac{4}{33}$
(c) $\frac{9}{10}, \frac{2}{5}$ (d) $\frac{3}{5}, \frac{4}{15}$

**[SSC (GL) Examination, 2011]**

**81.** If $a = 64$ and $b = 289$, then the value of $\left(\sqrt{\sqrt{a}+\sqrt{b}} - \sqrt{\sqrt{b}-\sqrt{a}}\right)^{\frac{1}{2}}$ is:

(a) $2^{1/2}$ (b) 2
(c) 4 (d) –2

**[SSC, 2014]**

**82.** If $\sqrt{x}=\sqrt{3}-\sqrt{5}$, then the value of $x^2 - 16x + 6$ is:

(a) 0 (b) –2
(c) 2 (d) 4

**[SSC, 2013]**

**83.** $2\sqrt[3]{40}-4\sqrt[3]{320}+3\sqrt[3]{635}-3\sqrt[3]{5}$ is equal to:

(a) $-2\sqrt[3]{340}$ (b) 0
(c) $\sqrt[3]{340}$ (d) $\sqrt[3]{660}$

**[SSC, 2012]**

**84.** The square root of $\frac{(0.75)^3}{1-0.75}+(0.75+(0.75)^2+1)$ is:

(a) 1 (b) 2
(c) 3 (d) 4

**[SSC, 2011]**

**85.** Given that $\sqrt{4096}=64$, the value of $\sqrt{4096}+\sqrt{40.96}+\sqrt{0.004096}$ is:

(a) 70.4 (b) 70.464
(c) 71.104 (d) 71.4

**[SSC, 2011]**

**86.** If $a2 = 2$, then $(a + 1)$ is equal to:

(a) $a - 1$ (b) $\frac{2}{a-1}$
(c) $\frac{a+1}{3-2a}$ (d) $\frac{a-1}{3-2a}$

**[SSC, 2010]**

**87.** The square root of $\frac{(0.75)^3}{1-0.75}+[0.75+(0.75)^2+1]$ is:

(a) 1 (b) 2
(c) 3 (d) 4

**[SSC, 2010]**

**88.** $\sqrt[3]{(13.608)^2-(13.392)^2}$ is equal to:

(a) 0.6 (b) 0.06
(c) 1.8 (d) 2.6

**[SSC, 2010]**

**89.** The square root of $\frac{9.5\times 0.0085\times 18.9}{0.0017\times 1.9\times 2.1}$ is:

(a) 15 (b) 45
(c) 75 (d) 225

**[SSC, 2010]**

**90.** The largest among the numbers $\sqrt{7}-\sqrt{5}$, $\sqrt{5}-\sqrt{3}$, $\sqrt{9}-\sqrt{7}$, $\sqrt{11}-\sqrt{9}$ is:

(a) $\sqrt{7}-\sqrt{5}$ (b) $\sqrt{5}-\sqrt{3}$
(c) $\sqrt{9}-\sqrt{7}$ (d) $\sqrt{11}-\sqrt{9}$

**[SSC, 2010]**

**91.** $\sqrt{1000000.000001}=?$

(a) 1000 (b) 100
(c) 1000.001 (d) 10000
(e) 999

**[IBPS PO/MT, 2013]**

**92.** $\left[\left(5\sqrt{7}+\sqrt{7}\right)\times\left(4\sqrt{7}+8\sqrt{7}\right)\right]-(19)^2=?$

(a) 143 (b) $72\sqrt{7}$
(c) 134 (d) $70\sqrt{7}$
(e) None of these

**[IBPS PO/MT, 2012]**

**93.** $\sqrt{33124}\times\sqrt{2601}-(83)^2=(?)^2+(37)^2$

(a) 37 (b) 33
(c) 34 (d) 28
(e) None of these

**[IBPS PO/MT, 2012]**

**Directions (Q. 94–101):** What approximate value should come in place of the question mark (?) in the following questions? (Note: You are not expected to calculate the exact value.)

**94.** $8787\div 343\times\sqrt{50}=?$

(a) 250 (b) 140
(c) 180 (d) 100
(e) 280

**[IBPS PO/MT, 2012]**

**95.** $\sqrt[3]{54821}\times(303\div 8)=(?)^2$

(a) 48 (b) 38
(c) 28 (d) 18
(e) 58

**[IBPS PO/MT, 2012]**

**96.** $[(3\sqrt{8}+\sqrt{8})\times(8\sqrt{8}+7\sqrt{8})]-98=?$

(a) $2\sqrt{8}$ (b) $8\sqrt{8}$
(c) 382 (d) 386
(e) None of these

**[IBPS PO/MT, 2011]**

**97.** $\sqrt{11449}\times\sqrt{6241}-(54)^2=\sqrt{?}+(74)^2$

(a) 3844 (b) 3721
(c) 3481 (d) 3638
(e) None of these

**[IBPS PO/MT, 2011]**

**98.** $\sqrt{6354}\times 34.993=?$

(a) 3000 (b) 2800
(c) 2500 (d) 3300
(e) 2600

**[IBPS PO/MT, 2011]**

**99.** $\sqrt[3]{4663}+349=?\div 21.003$

(a) 7600 (b) 7650
(c) 7860 (d) 7560
(e) 7680

**[IBPS PO/MT, 2011]**

**100.** $(15.01)^2\times\sqrt{730}=?$

(a) 6125 (b) 6225
(c) 6200 (d) 6075
(e) 6250

**[SBI Associates Banks PO, 2011]**

**101.** $\sqrt{54}\times\sqrt{2120}\div\sqrt{460}=?$

(a) 120 (b) 140
(c) 160 (d) 180
(e) 200

**[IOB PO, 2011]**

**Directions (Q. 102–107):** In the following questions two equations numbered I and II are given. You have to solve both the equations and

**Give answer If**

(a) $x > y$
(b) $x \geq y$
(c) $x < y$
(d) $x \leq y$
(e) $x = y$ or the relationship cannot be established.

**102. I.** $\sqrt{25x^2}-125=0$

**II.** $\sqrt{361}y+95=0$

**[Allahabad Bank PO, 2011]**

**103. I.** $\frac{5}{7}-\frac{5}{21}=\frac{\sqrt{x}}{42}$

**II.** $\frac{\sqrt{y}}{4}+\frac{\sqrt{y}}{16}=\frac{250}{\sqrt{y}}$

**[Allahabad Bank PO, 2011]**

**104. I.** $(625)^{\frac{1}{4}}x+\sqrt{1225}=155$

**II.** $\sqrt{196}y+13=279$

**[Allahabad Bank PO, 2011]**

**105. I.** $5x^2-18x+9=0$

**II.** $3y^2+5y-2=0$

**[Allahabad Bank PO, 2011]**

**106. I.** $\frac{13}{\sqrt{x}}+\frac{9}{\sqrt{x}}=\sqrt{x}$

**II.** $y^4-\frac{(13\times 2)^{\frac{9}{2}}}{\sqrt{y}}=0$

**[Allahabad Bank PO, 2011]**

**107.** $\sqrt{5^2\times 14-6\times 7+(4)^?}=18$

(a) 1 (b) 3
(c) 4 (d) 5
(e) None of these

**[Indian Bank PO, 2010]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (a) | **3.** (a) | **4.** (c) | **5.** (a) | **6.** (d) | **7.** (a) | **8.** (c) | **9.** (a) | **10.** (c) | **11.** (c) | **12.** (c) |
| **13.** (a) | **14.** (a) | **15.** (c) | **16.** (a) | **17.** (c) | **18.** (a) | **19.** (b) | **20.** (d) | **21.** (b) | **22.** (a) | **23.** (a) | **24.** (b) |
| **25.** (b) | **26.** (d) | **27.** (b) | **28.** (b) | **29.** (d) | **30.** (c) | **31.** (c) | **32.** (a) | **33.** (b) | **34.** (b) | **35.** (a) | **36.** (c) |
| **37.** (c) | **38.** (a) | **39.** (b) | **40.** (c) | **41.** (a) | **42.** (c) | **43.** (b) | **44.** (c) | **45.** (c) | **46.** (b) | **47.** (c) | **48.** (b) |
| **49.** (b) | **50.** (c) | **51.** (d) | **52.** (a) | **53.** (c) | **54.** (b) | **55.** (c) | **56.** (c) | **57.** (c) | **58.** (c) | **59.** (d) | **60.** (b) |

### Exercise-2

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (e) | **3.** (e) | **4.** (b) | **5.** (a) | **6.** (b) | **7.** (b) | **8.** (c) | **9.** (c) | **10.** (b) | **11.** (c) | **12.** (b) |
| **13.** (c) | **14.** (a) | **15.** (b) | **16.** (a) | **17.** (b) | **18.** (e) | **19.** (c) | **20.** (a) | **21.** (b) | **22.** (e) | **23.** (a) | **24.** (a) |
| **25.** (c) | **26.** (d) | **27.** (c) | **28.** (d) | **29.** (d) | **30.** (a) | **31.** (b) | **32.** (d) | **33.** (d) | **34.** (b) | **35.** (b) | **36.** (d) |
| **37.** (b) | **38.** (b) | **39.** (d) | **40.** (c) | **41.** (b) | **42.** (d) | **43.** (d) | **44.** (d) | **45.** (c) | **46.** (b) | **47.** (c) | **48.** (b) |
| **49.** (a) | **50.** (c) | **51.** (c) | **52.** (b) | **53.** (d) | **54.** (d) | **55.** (d) | **56.** (a) | **57.** (d) | **58.** (a) | **59.** (d) | **60.** (b) |
| **61.** (d) | **62.** (b) | **63.** (d) | **64.** (c) | **65.** (a) | **66.** (c) | **67.** (d) | **68.** (c) | **69.** (b) | **70.** (c) | **71.** (d) | **72.** (a) |
| **73.** (c) | **74.** (d) | **75.** (d) | **76.** (a) | **77.** (a) | **78.** (a) | **79.** (b) | **80.** (d) | **81.** (a) | **82.** (c) | **83.** (b) | **84.** (b) |
| **85.** (b) | **86.** (d) | **87.** (b) | **88.** (c) | **89.** (a) | **90.** (b) | **91.** (a) | **92.** (a) | **93.** (e) | **94.** (c) | **95.** (b) | **96.** (c) |
| **97.** (b) | **98.** (b) | **99.** (e) | **100.** (d) | **101.** (c) | **102.** (e) | **103.** (c) | **104.** (a) | **105.** (a) | **106.** (c) | **107.** (e) | |

## EXPLANATORY ANSWERS

### Exercise-1

**1. (c)** The prime factors of 4356 are

$$2 \times 2 \times 3 \times 3 \times 11 \times 11$$

$4356 = 2 \times 2 \times 3 \times 3 \times 11 \times 11$

$$\begin{array}{r|r}
2 & 4356 \\ \hline
2 & 2178 \\ \hline
3 & 1089 \\ \hline
3 & 363 \\ \hline
11 & 121 \\ \hline
11 & 11 \\ \hline
 & 1
\end{array}$$

$\sqrt{4356} = \sqrt{2^2 \times 3^2 \times 11^2}$

$= 2 \times 3 \times 11 = 66.$

**2. (a)**

$$\begin{array}{r|l}
 & 324 \\ \hline
3 & \overline{10}\ \ \overline{49}\ \ \overline{76} \\
 & 9 \\ \hline
62 & 149 \\
 & 124 \\ \hline
644 & 2576 \\
 & 2576 \\ \hline
 & \times
\end{array}$$

$\therefore$ Square root of 104976 is 324.

**3. (a)**

$$\begin{array}{r|l}
 & 460 \\ \hline
4 & \overline{21}\ \ \overline{16}\ \ \overline{00} \\
 & 16 \\ \hline
86 & 516 \\
 & 516 \\ \hline
 & \times
\end{array}$$

$\therefore$ Square root of 211600 is 460.

**4. (c)**

| | 2548 |
|---|---|
| 2 | $6\ \overline{49}\ \overline{23}\ \overline{04}$ |
| | 4 |
| 45 | 249 |
| | 225 |
| 644 | 2423 |
| | 2016 |
| 5088 | 40704 |
| | 40704 |
| | × |

$\therefore \sqrt{6492304} = 2548.$

**5. (a)** $74088 = 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 7 \times 7 \times 7$

$= (2 \times 2) \times (3 \times 3) \times (7 \times 7) \times (2 \times 3 \times 7)$

Therefore, required number $= 2 \times 3 \times 7 = 42$.

| | |
|---|---|
| 2 | 74088 |
| 2 | 37044 |
| 2 | 18522 |
| 3 | 6261 |
| 3 | 3087 |
| 3 | 1029 |
| 7 | 343 |
| 7 | 49 |
| 7 | 7 |
| | 1 |

**6. (d)** $\sqrt{10} \times \sqrt{250} = \sqrt{2500} = 50.$

**7. (a)** $\sqrt{80} + 3\sqrt{245} - \sqrt{125} = 4\sqrt{5} + 21\sqrt{5} - 5\sqrt{5}.$

$= 20\sqrt{5}.$

**8. (c)** Let, $\dfrac{250}{\sqrt{x}} = 10$. Then, $\sqrt{x} = \dfrac{250}{10} = 25$

$\therefore \quad x = (25)^2 = 625.$

**9. (a)** $\dfrac{\sqrt{256}}{\sqrt{x}} = 2$ or, $\dfrac{16}{\sqrt{x}} = 2$

$\therefore \quad 16 = 2\sqrt{x} \quad \Rightarrow \quad \sqrt{x} = 8$ or, $x = 64$.

**10. (c)** We know that

$216 = 2 \times 2 \times 2 \times 3 \times 3 \times 3 = 2^2 \times 3^2 \times 6$

Thus, $\dfrac{216}{6} = 2^2 \times 3^2 = 6^2.$

Therefore, 216 should be divided by 6, so that the result is a perfect square.

**11. (c)** Let, $\dfrac{\sqrt{x}}{200} = 0.02$. Then,

$\sqrt{x} = 200 \times 0.02$ or, $\sqrt{x} = 4$

So, $x = 16$.

**12. (c)** $\dfrac{\sqrt{6727}}{\sqrt{7}} = \dfrac{\sqrt{6727}}{\sqrt{7}} = \sqrt{961} = 31.$

**13. (a)** $\sqrt{0.09} = \sqrt{\dfrac{9}{100}} = \dfrac{3}{10} = 0.3.$

**14. (a)** $\dfrac{14}{3+\sqrt{2}} = \dfrac{14(3-\sqrt{2})}{(3-\sqrt{2})(3+\sqrt{2})} = \dfrac{14(3-\sqrt{2})}{9-2}$

$= 2(3 - \sqrt{2}) = 2(3 - 1.414)$

$= 2 \times 1.586 = 3.172.$

**15. (c)** The number nearest to 3579 which is a perfect square is 3600.

$\therefore$ Required number $= 60^2 - 3579 = 21$.

**16. (a)** $\sqrt{\left(1 + \dfrac{27}{169}\right)} = 1 + \dfrac{x}{13}$

$\therefore \quad \sqrt{\dfrac{196}{169}} = 1 + \dfrac{x}{13}$

or, $\dfrac{14}{13} = 1 + \dfrac{x}{13}$ or, $\dfrac{x}{13} = \dfrac{14}{13} - 1$

or, $\dfrac{x}{13} = \dfrac{1}{13}$ or, $x = 1$.

**17. (c)** $\dfrac{\sqrt{4375}}{\sqrt{7}} = \dfrac{\sqrt{4375}}{\sqrt{7}} = \sqrt{625} = 25.$

**18. (a)** $\sqrt{0.016a} = 0.016 \times \sqrt{b}$

$\Rightarrow \quad \sqrt{\dfrac{a}{b}} = \dfrac{0.016}{\sqrt{0.016}} \Rightarrow \sqrt{\dfrac{a}{b}} = \sqrt{0.016} \Rightarrow \dfrac{a}{b} = 0.016.$

**19. (b)** $\sqrt{\sqrt[3]{\sqrt[3]{\sqrt[3]{3.3^{1/2}}}}} = \sqrt{\sqrt[3]{\sqrt[3]{3.3^{3/4}}}} = \sqrt{\sqrt[3]{3.3^{7/8}}}$

$= \sqrt{3.3^{15/16}} = 3^{31/32}.$

**20. (d)** Let, $\dfrac{\sqrt{1296}}{x} = \dfrac{x}{2.25}$

Then, $\dfrac{36}{x} = \dfrac{x}{2.25}$

or, $x^2 = 36 \times \dfrac{225}{100}$

$\therefore \quad x = \sqrt{\dfrac{36 \times 225}{100}} = \dfrac{6 \times 15}{10} = 9.$

**21. (b)** $\sqrt{176 + \sqrt{2401}} = \sqrt{176 + 49} = \sqrt{225} = 15.$

**22. (a)** $\sqrt{10} \times \sqrt{15} = \sqrt{150} = \sqrt{25 \times 6}$

$= \sqrt{25} \times \sqrt{6} = 5\sqrt{6}.$

**23. (a)** $\dfrac{\sqrt{4}}{\sqrt{3}} - \dfrac{\sqrt{3}}{\sqrt{4}} = \dfrac{2}{\sqrt{3}} - \dfrac{\sqrt{3}}{2} = \dfrac{4-3}{2\sqrt{3}} = \dfrac{1}{2\sqrt{3}}.$

**24. (b)** $\sqrt{248 + \sqrt{52 + \sqrt{144}}} = \sqrt{248 + \sqrt{52 + 12}}$

$= \sqrt{248 + \sqrt{64}}$

$= \sqrt{248 + 8}$

$= \sqrt{256} = 16.$

**25. (b)** Given expression $= \dfrac{\sqrt{0.0009}}{\sqrt{0.01}} = \sqrt{\dfrac{0.0009}{0.0100}}$

$= \sqrt{\dfrac{9}{100}} = \dfrac{3}{10} = 0.3.$

**26. (d)** $\dfrac{1}{\sqrt{9}-\sqrt{8}}=\dfrac{1}{\sqrt{9}-\sqrt{8}}\times\dfrac{\sqrt{9}+\sqrt{8}}{\sqrt{9}+\sqrt{8}}=\dfrac{3+2\sqrt{2}}{9-8}$

$= 3 + 2\sqrt{2}$.

**27. (b)** $\sqrt{\dfrac{x}{169}}=\dfrac{54}{39} \Rightarrow \dfrac{x}{169}=\dfrac{54}{39}\times\dfrac{54}{39}$

$\therefore\ x=\dfrac{54}{39}\times\dfrac{54}{39}\times 169 = 324.$

**28. (b)** Let, given expression = $x$

Then, $\sqrt{12+x}=x \Rightarrow 12 + x = x^2$

$\therefore\ x^2 - x - 12 = 0$ or, $(x - 4)(x + 3) = 0$

So, $x = 4$ (neglecting $x = -3$).

**29. (d)** Given expression

$=\dfrac{112}{14}\times\dfrac{24}{12}\times\dfrac{16}{8} = 32.$

**30. (c)** $\sqrt{\dfrac{3}{4}}+2\sqrt{\dfrac{4}{3}}=\sqrt{12}\left(\dfrac{1}{4}+\dfrac{2}{3}\right)$

$=\dfrac{3.464\times 11}{12} = 3.1753.$

**31. (c)** Given expression

$=\sqrt{15625}+\sqrt{\dfrac{15625}{100}}+\sqrt{\dfrac{15625}{10000}}$

$=125+\dfrac{125}{10}+\dfrac{125}{100}$

$= 125 + 12.5 + 1.25 = 138.75.$

**32. (a)** $\sqrt{0.03\times 0.3\times a} = 0.03 \times 0.3 \times\sqrt{b}$

$\Rightarrow \sqrt{\dfrac{a}{b}}=\sqrt{0.03\times 0.3}$

$\Rightarrow \dfrac{a}{b} = 0.03 \times 0.3$

or, $\dfrac{a}{b} = 0.009.$

**33. (b)** $\sqrt{4096}+\sqrt{40.96}+\sqrt{.004096}$

$= \sqrt{4096}+\sqrt{\dfrac{4096}{100}}+\sqrt{\dfrac{4096}{1000000}}$

$= 64 +\dfrac{64}{10}+\dfrac{64}{1000}$

$= 64 + 6.4 + 0.064 = 70.464.$

**34. (b)** $\sqrt{1+\sqrt{1-\dfrac{2176}{2401}}} = 1 +\dfrac{x}{7}$

$\Rightarrow 1 +\dfrac{x}{7}=\sqrt{1+\sqrt{\dfrac{225}{2401}}}=\sqrt{1+\dfrac{15}{49}}$

$=\sqrt{\dfrac{64}{49}}=\dfrac{8}{7}=1+\dfrac{1}{7} \qquad \therefore\ x = 1.$

**35. (a)** The square of an odd number cannot have 4 as the unit digit. The square of a 3-digit number will have at least 5 digits and at the most 6 digits.

**36. (c)** Given expression

$=\sqrt{\dfrac{324\times 81\times 4624}{15625\times 289\times 729\times 64}}$

(Sum of decimal places being equal in numerator and denominator)

$=\dfrac{18\times 9\times 68}{125\times 17\times 27\times 8}=\dfrac{3}{125} = 0.024.$

**37. (c)** $\sqrt[3]{\dfrac{512}{3375}}=\sqrt[3]{\dfrac{2\times 2\times 2\times 2\times 2\times 2\times 2\times 2\times 2}{3\times 3\times 3\times 5\times 5\times 5}}$

$=\dfrac{2\times 2\times 2}{3\times 5}=\dfrac{8}{15}$ .

**38. (a)** Given expression

$=\sqrt{0.01+0.08}=\sqrt{0.09}$

$=\sqrt{\dfrac{9}{100}}=\dfrac{3}{10}= 0.3.$

**39. (b)** $\sqrt[3]{15.625}=\sqrt[3]{\dfrac{15625}{1000}}=\sqrt[3]{\dfrac{5\times 5\times 5\times 5\times 5\times 5}{2\times 2\times 2\times 5\times 5\times 5}}$

$=\dfrac{5\times 5}{2\times 5}=\dfrac{5}{2} = 2.5.$

**40. (c)** $\sqrt[3]{0.000064}=\sqrt[3]{\dfrac{64}{1000000}}$

$=\sqrt[3]{\dfrac{4\times 4\times 4}{100\times 100\times 100}}$

$=\dfrac{4}{100} = 0.04.$

**41. (a)** $\sqrt[3]{\sqrt{441}+\sqrt{16}+\sqrt{4}}$

$=\sqrt[3]{21+4+2}=\sqrt[3]{27}$

$=\sqrt[3]{3\times 3\times 3} = 3.$

**42. (c)** $14175 = 5 \times 5 \times 3 \times 3 \times 3 \times 3 \times 7$

$= 5^2 \times 3^4 \times 7$

It must be multiplied by 7.

**43. (b)** $\dfrac{\sqrt{5}-\sqrt{3}}{\sqrt{5}+\sqrt{3}}\times\dfrac{\sqrt{5}-\sqrt{3}}{\sqrt{5}-\sqrt{3}}$

$=\dfrac{(\sqrt{5}-\sqrt{3})^2}{5-3}=\dfrac{5+3-2\sqrt{15}}{2}$

$=\dfrac{2(4-\sqrt{15})}{2}=4-\sqrt{15}.$

**44. (c)** $\dfrac{\sqrt{24}+\sqrt{216}}{\sqrt{96}}=\dfrac{\sqrt{4\times 6}+\sqrt{36\times 6}}{\sqrt{16\times 6}}$

$=\dfrac{2\sqrt{6}+6\sqrt{6}}{4\sqrt{6}}=\dfrac{8\sqrt{6}}{4\sqrt{6}} = 2.$

**45.** **(c)** $\sqrt{2\frac{2}{9}} = \frac{\sqrt{20}}{\sqrt{9}} = \frac{\sqrt{20}}{3} = \frac{4.472}{3} = 1.491 \approx 1.49.$

**46.** **(b)** $a = \frac{\sqrt{5}+1}{\sqrt{5}-1} \times \frac{\sqrt{5}+1}{\sqrt{5}+1} = \frac{(\sqrt{5}+1)^2}{(\sqrt{5})^2-(1)^2}$

$= \frac{5+1+2\sqrt{5}}{5-1}$

$= \frac{6+2\sqrt{5}}{4} = \frac{3+\sqrt{5}}{2}$

$b = \frac{\sqrt{5}-1}{\sqrt{5}+1} \times \frac{\sqrt{5}-1}{\sqrt{5}-1} = \frac{(\sqrt{5}-1)^2}{(\sqrt{5})^2-(1)^2}$

$= \frac{5+1-2\sqrt{5}}{5-1} = \frac{6+2\sqrt{5}}{4} = \frac{3-\sqrt{5}}{2}$

$a^2 + b^2 = \frac{(3+\sqrt{5})^2+(3-\sqrt{5})^2}{4}$

$= \frac{9+5+6\sqrt{5}+9+5-6\sqrt{5}}{5} = \frac{28}{4} = 7$

$ab = 1$

$\therefore \quad \frac{a^2+ab+b^2}{a^2-ab+b^2} = \frac{7+1}{7-1} = \frac{8}{6} = \frac{4}{3}$

**47.** **(c)** $10584 = 4 \times 9 \times 2 \times 7 \times 7 \times 3$

$= 2^2 \times 3^2 \times 7^2 \times 2 \times 3$

This must be multiplied by 6.

**48.** **(b)** $7936 = 4 \times 4 \times 4 \times 4 \times 31$

To make it a perfect square, we multiply it by 31

$\therefore$ The required T smallest number

$= 7936 \times 31 = 246016.$

**49.** **(b)** $\sqrt{.00059049} = \sqrt{\frac{59049}{100000000}}$

$= \frac{\sqrt{59049}}{\sqrt{100000000}}$

$= \frac{243}{10000} = 0.0243.$

**50.** **(c)** $\sqrt{\frac{4}{12.1}} = \sqrt{\frac{4\times10}{12.1\times10}} = \frac{\sqrt{4}\times\sqrt{10}}{\sqrt{121}}$

$= \frac{2}{11}\times\sqrt{10} = \frac{2}{11}\times3.16$

$= \frac{6.32}{11} = 0.57 \approx 0.6.$

**51.** **(d)** Given expression

$= \sqrt{\frac{256\times81\times4356}{15625\times121\times1296\times64}}$

$= \frac{16\times9\times66}{125\times11\times36\times8} = 0.024.$

**52.** **(a)** The number of men in the front row is the square root of 16160 – 31, that is 16129, which is 127.

**53.** **(c)** Ratio of their sides is the ratio of their square roots

$= \sqrt{420.25} : \sqrt{441}$

$= 20.5:21 = 41:42.$

**54.** **(b)** The number of men in the front row is the square root of 5180 + 4, that is 5184, which is 72.

**55.** **(c)** The largest number of three digits is 999,

$$\begin{array}{r|l} & 31 \\ \hline 3 & 999 \\ & 9 \\ \hline 61 & 99 \\ & 61 \\ \hline & 38 \end{array}$$

$\therefore$ Required number is $(31)^2 = 961.$

**56.** **(c)** $21\frac{15}{289} = \frac{6084}{289} = \left(\frac{78}{17}\right)^2$

$\therefore$ Square root $= \frac{78}{17} = 4\frac{10}{17}.$

$\therefore$ Least fraction to be subtracted $= \frac{10}{17}.$

**57.** **(c)**

$$\begin{array}{r|l} & 250 \\ \hline 2 & 6\overline{2}\ \ 5\ \ \overline{1}2 \\ & 4 \\ 45 & 225 \\ & 225 \\ \hline 50 & 12 \end{array}$$

So, 12 is the smallest number, which, when subtracted from 62512 makes it a perfect square.

$\sqrt{62500} = 250.$

**58.** **(c)** Largest number of 5 digits = 99999.

$$\begin{array}{r|l} & 316 \\ \hline 3 & 9\ \overline{99}\ \ \overline{99} \\ & 9 \\ \hline 61 & 99 \\ & 61 \\ \hline 625 & 3899 \\ & 3756 \\ \hline & 143 \end{array}$$

The required number $= (316)^2 = 99856.$

**59.** **(d)** $2450 = 5 \times 5 \times 7 \times 7 \times 2$

$\therefore$ 2450 must be multiplied by 2.

**60.** **(b)** $3600 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 5 \times 5$

$= 2^2 \times 2^2 \times 3^2 \times 5^2$

$\therefore$ 3600 should be multiplied by $2 \times 2 \times 3 \times 5$, that is 60, to make it a perfect cube.

## EXERCISE-2
## (BASED ON MEMORY)

**1. (c)** Given expression = 6.4 + 0.64 + 0.064 + 0.0064
= 7.1104 = 7.11

**2. (e)** $\sqrt[3]{19683} = ? \times 3 \quad \therefore\ ? = \frac{\sqrt[3]{19683}}{3} = \frac{27}{3} = 9$

**3. (e)** $\sqrt{\sqrt{1024}+\sqrt{7921}} \times 48.5 = \sqrt{32+89} \times 48.5$

$= \sqrt{121} \times 48.5 = 11 \times 48.5 = 533.5$

**4. (b)** $\sqrt{\sqrt{2500}+\sqrt{961}} = \sqrt{50+31} = \sqrt{81} = 9$

Now, $(?)^2 = 9 \qquad \therefore\ ? = 3$

**5. (a)** 21952 = 4 × 4 × 4 × 7 × 7 × 7

$\therefore\ \sqrt[3]{21952} = 4 \times 7 = 28.$

**6. (b)** $\frac{1}{\sqrt{5}-\sqrt{3}} = \frac{1}{\sqrt{5}-\sqrt{3}} \times \frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}+\sqrt{3}}$

$= \frac{\sqrt{5}+\sqrt{3}}{5-3} = \frac{2.2361+1.7321}{2}$

$= \frac{3.9682}{2} = 1.9841.$

**7. (b)** $\frac{\sqrt{625}}{11} \times \frac{14}{\sqrt{25}} \times \frac{11}{\sqrt{196}} = \frac{25}{11} \times \frac{14}{5} \times \frac{11}{14} = 5.$

**8. (c)** $\sqrt{272^2 - 128^2} = \sqrt{(272+128)(272-128)}$

$= \sqrt{400 \times 144}$

$= 20 \times 12 = 240.$

**9. (c)** $\sqrt{0.9} = \sqrt{\frac{9}{10}} = \frac{3}{10} \times \frac{\sqrt{10}}{\sqrt{10}}$

$= \frac{3 \times 3.16}{10} = \frac{9.48}{10} = 0.94.$

**10. (b)** $\frac{\sqrt{0.441}}{\sqrt{0.625}} = \frac{\sqrt{441}}{\sqrt{625}} = \frac{21}{25} = 0.84.$

**11. (c)** $\frac{0.342 \times 0.684}{0.000342 \times 0.000171} = \frac{342 \times 684 \times 10^6}{342 \times 171}$

$= 4 \times 10^6$

Square root of $4 \times 10^6 = 2 \times 10^3 = 2000$.

**12. (b)** $\sqrt{0.01} + \sqrt{0.81} + \sqrt{1.21} + \sqrt{0.0009}$

= 0.1 + 0.9 + 1.1 + 0.03 = 2.13.

**13. (c)** $\sqrt[3]{175.616} = \sqrt[3]{\frac{175616}{10000}} = \frac{56}{10} = 5.6$

$\sqrt[3]{0.175616} = \sqrt[3]{\frac{175616}{1000000}} = \frac{56}{100} = 0.56$

$\sqrt[3]{0.000175616} = \sqrt[3]{\frac{175616}{1000000000}} = \frac{56}{1000} = 0.056$

$\therefore$ Required answer = 5.6 + 0.56 + 0.056 = 6.216.

**14. (a)** $\sqrt{8} + 2\sqrt{32} - \sqrt[3]{128} + \sqrt[4]{50}$

$= 2\sqrt{2} + 2 \times 4\sqrt{2} - 3 \times 8\sqrt{2} + 4 \times 5\sqrt{2}$

$= 2\sqrt{2} + 8\sqrt{2} - 24\sqrt{2} + 20\sqrt{2}$

$= 6\sqrt{2} = 6 \times 1.414 = 8.484.$

**15. (b)** $\sqrt{\sqrt[3]{0.004096}} = \sqrt{((0.16)^3)^{1/3}} = \sqrt{0.16} = 0.4.$

**16. (a)** $\sqrt{\frac{5}{3}} = \sqrt{\frac{5 \times 3}{3 \times 3}} = \sqrt{\frac{15}{3}} = \frac{3.88}{3} = 1.29\overline{3}.$

**17. (b)** $\sqrt{5625} + \sqrt{56.25} + \sqrt{0.5625}$

$= \sqrt{5625} + \sqrt{\frac{5625}{100}} + \sqrt{\frac{5625}{1000}} = 75 + \frac{75}{10} + \frac{75}{100}$

= 75 + 7.5 + 0.75 = 83.25.

**18. (e)** $\frac{36}{6} \times \sqrt{?} = 108$

or, $\sqrt{?} = \frac{108}{6}$ or, $\sqrt{?} = 18$ or, $? = 324 \approx 325.$

**19. (c)** $? = \sqrt{1223.9975} \approx 34.$

**20. (a)** $? = \sqrt{\sqrt{20800}} = \sqrt{144} = 12.$

**21. (b)** $\sqrt{10000} + \frac{3.001}{4.987}$ of 1891.992 = ?

or, $? \approx 100 + \frac{3}{5}$ of $1900 = 100 + 1140 \approx 1230.$

**22. (e)** $\sqrt{?} = \pm 75$

Squaring on both sides, we get

? = 75 × 75 = 5625.

**23. (a)** 2.25 × 0.15 = 0.3375.

**24. (a)** $\left(\frac{8}{125}\right)^{-4/3} = \left(\frac{2}{5}\right)^{-4} = \left(\frac{5}{2}\right)^{4} = \frac{625}{16}.$

**25. (c)** $\frac{(1+\sqrt{2})(\sqrt{5}-\sqrt{3}) + (1-\sqrt{2})(\sqrt{5}+\sqrt{3})}{5-3}$

$= \frac{\sqrt{5}-\sqrt{3}+\sqrt{10}-\sqrt{6}+\sqrt{5}+\sqrt{3}-\sqrt{10}-\sqrt{6}}{2}$

$= \frac{2\left(\sqrt{5}-\sqrt{6}\right)}{2} = \sqrt{5}-\sqrt{6}.$

**26. (d)** $x = 7 - 4\sqrt{3}$

$\frac{1}{x} = \frac{1}{7-4\sqrt{3}} \times \frac{7+4\sqrt{3}}{7+4\sqrt{3}}$

$= 7 + 4\sqrt{3}$

$\therefore \quad x + \dfrac{1}{x} = 14.$

**27.** **(c)** $7^{1/4} \times (7^3)^{1/4} = 7.$

**28.** **(d)** $a^n - 1$ is always divisible by $a - 1$.

$\therefore$ $49^{15} - 1$ is divisible by 48, i.e., 8.

**29.** **(d)** $\left(1+\dfrac{1}{x}\right)\left(1+\dfrac{1}{x+1}\right)\left(1+\dfrac{1}{x+2}\right)\left(1+\dfrac{1}{x+3}\right)$

$= \left(\dfrac{x+1}{x}\right)\left(\dfrac{x+2}{x+1}\right)\left(\dfrac{x+3}{x+2}\right)\left(\dfrac{x+4}{x+3}\right)$

$= \dfrac{x+4}{x}.$

**30.** **(a)** $\dfrac{1}{2} - \dfrac{1}{4} + \dfrac{1}{5} - \dfrac{1}{6} = \dfrac{30-15+12-10}{60} = \dfrac{17}{60}$

$\dfrac{2}{5} - \dfrac{5}{9} + \dfrac{3}{5} - \dfrac{7}{18} = \dfrac{36-50+54-35}{90} = \dfrac{5}{90}$

As per the question $\dfrac{17/60}{5/90} = \dfrac{51}{10} = 5\dfrac{1}{10}.$

**31.** **(b)** $\left[\dfrac{\sqrt{5}+\sqrt{3}}{\sqrt{5}-\sqrt{3}}\right]^2 + \left[\dfrac{\sqrt{5}-\sqrt{3}}{\sqrt{5}+\sqrt{3}}\right]^2$

$= \left[\dfrac{(\sqrt{5}+\sqrt{3})(\sqrt{3}+\sqrt{3})}{(\sqrt{5}-\sqrt{3})(\sqrt{5}+\sqrt{3})}\right]^2 + \left[\dfrac{(\sqrt{5}-\sqrt{3})(\sqrt{5}-\sqrt{3})}{(\sqrt{5}+\sqrt{3})(\sqrt{5}-\sqrt{3})}\right]^2$

$= \left[\dfrac{5+3+2\sqrt{15}}{5-3}\right]^2 + \left[\dfrac{5+3-2\sqrt{15}}{5-3}\right]^2$

$= \left[4+\sqrt{15}\right]^2 + \left[4-\sqrt{15}\right]^2$

$= 16 + 15 + 8\sqrt{15} + 16 + 15 - 8\sqrt{15}$

$= 16 + 15 + 16 + 15$ or, 62.

**32.** **(d)** $25^{25} = (26 - 1)^{25}$

$= 26^{25} + 25_{C_1} \times 26^{24} \times (-1)^1$

$+ 25_{C_2} \times 26^{23} \times (-1)^2 + \cdots + (-1)^{25}$

[using Binomial theorem]

Now, all the terms are divisible by 26 except the last term $(-1)^{25}$. So, the remainder is $26 - 1 = 25$.

**33.** **(d)** Let, $x = \sqrt{6+\sqrt{6+\sqrt{6+\cdots}}}$

On squaring, we get

$x^2 = 6 + x$ or $x^2 - x - 6 = 0$

or, $(x - 3)(x + 2) = 0$ or, $x = 3, -2$

But, –ve value cannot be accepted.

$\therefore \quad x = 3.$

**34.** **(b)** Given expression $= (2^4)^{0.16} \times (2^4)^{0.04} \times (2)^{0.2}$

$= 2^{0.64} \times 2^{0.16} \times 2^{0.2}$

$= 2^1 = 2.$

**35.** **(b)** Number $= 269 \times 68 = 18292$

$= 67 \times 273 + 1.$

**36.** **(d)** $\dfrac{5}{3} \div \dfrac{2}{7} \times \dfrac{*}{7} = \dfrac{5}{4} \times \dfrac{2}{3} \div \dfrac{1}{6}$

or $\dfrac{5}{3} \times \dfrac{7}{2} \times \dfrac{*}{7} = \dfrac{5}{4} \times \dfrac{2}{3} \times \dfrac{6}{1}$

or $* = \dfrac{5}{4} \times \dfrac{2}{3} \times \dfrac{6}{1} \times \dfrac{3}{5} \times \dfrac{2}{7}$

Hence, * = 6.

**37.** **(b)** Suppose certain amount is ₹$x$.

Then, $\left(x - \dfrac{3}{16}x - \dfrac{x}{4}\right) \quad 81$

or, $16x - 3x - 4x = 81 \times 16$

or, $x = \dfrac{81 \times 16}{9} = 144$

Hence $B$ gets $= 144 \times \dfrac{1}{4} =$ ₹36.

**38.** **(b)** 1 * 2 = 1 + 2 × 6 = 1 + 12 = 13

(1 * 2) * 3 = 13 * 3 = 13 + 3 × 6 = 31.

**39.** **(d)** The given expression

$= \dfrac{2}{1+\dfrac{2}{2-1}} \times \dfrac{3}{\dfrac{5}{4} \div \dfrac{5}{4}} = \dfrac{2}{3} \times 3 = 2.$

**40.** **(c)** The man has $1 - \left(\dfrac{1}{3} + \dfrac{2}{3} + \dfrac{1}{5}\right) = \dfrac{1}{15}$

$\therefore$ man's income = 400 × 15 = ₹6000.

**41.** **(b)** 2 * 3 + 3 * 4

= [2 (2) + 3 (3)] + [2 (3) + 3 (4)]

= [4 + 9] + [6 + 12] = 31.

**42.** **(d)** Given expression

$= \left[\left\{(2^9)^{1/6}\right\}^{1/3}\right]^4 \times \left[\left\{(2^9)^{1/3}\right\}^{1/6}\right]^4$

$= (2^{1/2})^4 \times (2^{1/2})^4 = 2^2 \times 2^2 = 2^4.$

**43.** **(d)** Given expression

$= \sqrt{10+\sqrt{25+\sqrt{108+\sqrt{154+15}}}} = \sqrt{10+\sqrt{25+\sqrt{108+13}}}$

$= \sqrt{10+\sqrt{25+11}} = \sqrt{10+6} = \sqrt{16} = 4.$

**44.** **(d)** Let the number be $x$

Then, $\dfrac{2}{5} \times \dfrac{1}{3} \times \dfrac{3}{7} \times x = 15$

or, $\dfrac{2x}{35} = 15$ or $x = \dfrac{15 \times 35}{2}$

$\therefore$ 40 % of $x = \dfrac{40}{100} \times \dfrac{15 \times 35}{2} = 105.$

**45.** **(c)** Required number $= \dfrac{2}{5} \times 200 - \dfrac{3}{5} \times 125$

$= 80 - 75 = 5.$

**46. (b)** $\frac{2}{3}=\frac{2\times 165}{3\times 165}=\frac{330}{495}$

$\frac{3}{5}=\frac{3\times 99}{5\times 99}=\frac{297}{495}$

$\frac{7}{9}=\frac{7\times 55}{9\times 55}=\frac{385}{495}$

$\frac{9}{11}=\frac{9\times 45}{11\times 45}=\frac{405}{495}$

$\frac{8}{9}=\frac{8\times 55}{9\times 55}=\frac{440}{495}$

Ascending order $\frac{3}{5},\frac{2}{3},\frac{7}{9},\frac{9}{11},\frac{8}{9}$.

**47. (c)** $((47)^{1/2})^{15} \div ((47)^{1/2})^{3} \times ((47)^{1/2})^{-6} = (\sqrt{47})^{?}$

$=(\sqrt{47})^{15}\div(\sqrt{47})^{3}\times(\sqrt{47})^{-6}$

$=(\sqrt{47})^{?}$

$\Rightarrow \quad (\sqrt{47})^{15-3-6}=(\sqrt{47})^{?}$

$\therefore \quad ? = 6.$

**48. (b)** $? = \frac{(10008.99)^2}{10009.001}\times\sqrt{3589}\times 0.4987$

$\approx (10009) \times \sqrt{3600} \times 0.50$

$\approx (10009) \times 60 \times 0.50 \approx 300000.$

**49. (a)** Difference between two lowest numbers

= 16 – 7 = 9

Difference between two highest numbers

= 91 – 89 = 2

$\therefore$ Product of these two numbers = 9 × 2 = 18.

**50. (c)** $\frac{1}{5}\ I = \frac{5}{8}\ II$

$\therefore \quad \frac{I}{II}=\frac{25}{8}$

$I + 35 = 4\ II$

or, $\frac{25}{8}\ II + 35 = 4\ II$

$\therefore \quad II = 40.$

**51. (c)** $9^3 \times 81^2 \div 27^3 = (3)^?$

$3^{2\times 3} \times 3^{4\times 2} \div 3^{3\times 3} = (3)^?$

$3^6 \times 3^8 \div 3^9 = (3)^?$

$(3)^{6+8-9} = (3)^?$

$(3)^5 = (3)^?$

$? = 5$

**52. (b)** $(35)^2 \div \sqrt[3]{125} + (25)^2 \div 125 = ?$

$\frac{1225}{5}+\frac{625}{125} = ? \quad (\because \sqrt[3]{125}=5)$

245 + 5 = ?

250 = ?

**53. (d)** $(?)^2 \times (12)^2 \div (48)^2 = 81$

$\frac{(?)^2\times 12\times 12}{48\times 48} = 81$

$(?)^2 = 81 \times 16 = (9 \times 4)^2$

$\therefore \quad ? = 36$

**54. (d)** $? = \sqrt{1225}$

$\Rightarrow \quad ? = \sqrt{5\times5\times7\times7}$

$\Rightarrow \quad ? = 5 \times 7$

$\Rightarrow \quad ? = 35$

**55. (d)** $\frac{?}{49}=\frac{16}{?}$

$\Rightarrow \quad ?^2 = 49 \times 16$

$\Rightarrow \quad ? = \sqrt{49\times 16}$

$\Rightarrow \quad ? = \sqrt{7\times7\times4\times4}$

$\Rightarrow \quad ? = 7 \times 4$

$\Rightarrow \quad ? = 28$

**56. (a)** $\sqrt{898} \times (12.005)^2 + ? = 5000$

$\Rightarrow \quad \sqrt{900} \times (12)^2 + ? \approx 5000$

[898 ≈ 900; 12.005 ≈ 12]

$\Rightarrow \quad 30 \times 144 + ? \approx 5000$

$\Rightarrow \quad ? + 4320 \approx 5000$

$? = 5000 - 4320$

$\approx 680$

**57. (d)** $? = \sqrt{\sqrt{44944}+\sqrt{52441}}$

$\Rightarrow \quad ? = \sqrt{212+229}$

$\Rightarrow \quad ? = \sqrt{441}$

$\Rightarrow \quad ? = 21$

**58. (a)** $\frac{?}{171}=\frac{76}{?}$

$\therefore \quad (?)^2 = 171 \times 76$

$\Rightarrow \quad ? = \sqrt{171\times 76}$

$\Rightarrow \quad ? = \sqrt{12996}$

$\Rightarrow \quad ? = 114$

**59. (d)** $(72)^2 + (61)^2 = (199)^2 - (?)^2 - 420$

$(?)^2 = (199)^2 - 420 - (72)^2 - (61)^2$

$(?)^2 = 39601 - 420 - 5184 - 3721$

$(?)^2 = 39601 - 9325$

$(?) = \sqrt{30276} = 174$

**60. (b)** $\frac{?}{944}=\frac{59}{?}$

$(?) = 944 \times 59 = 55696$

$? = \sqrt{55696} = 236$

**61. (d)** $\sqrt[3]{4913} + 349 = \frac{?}{21}$

$\Rightarrow \quad (17 + 349) \times 21 = ?$

$\Rightarrow \quad ? = 366 \times 21 = 7686 \approx 7680$

**62.** **(b)** $\sqrt{6400} \times 35 = 80 \times 35 = 2800$

**63.** **(d)** $? = \sqrt[3]{1331}$

$= \sqrt[3]{11 \times 11 \times 11}$

$= 11$

**64.** **(c)** $\sqrt{24^4} + 224 = ? \times 202$

$\Rightarrow\ 24^2 + 224 = ? \times 400$

$\Rightarrow\ 576 + 224 = ? \times 400$

$\Rightarrow\ 800 = ? \times 400$

$\Rightarrow\ ? = \dfrac{800}{400} = 2$

**65.** **(a)** $\dfrac{?}{576} = \dfrac{256}{?}$

$\Rightarrow\ ?^2 = 256 \times 576$

$\Rightarrow\ ? = \sqrt{256 \times 576}$

$= 16 \times 24 = 384$

**66.** **(c)** $\dfrac{?}{432} = \dfrac{243}{?}$

$\Rightarrow\ (?)^2 = 432 \times 243$

$? = \sqrt{104976} = 324.$

**68.** **(c)** $(?)^3 = 4913$

$(?)^3 = (17)^3$

$\therefore\ ? = 17$

**69.** **(b)** $348 \div 29 \times 15 \div 156 = (?)^3 + 120$

$\Rightarrow\ 12 \times 15 + 156 = (?)^3 + 120$

$\Rightarrow\ 180 + 156 - 120 = (?)^3$

$\Rightarrow\ 216 = (?)^3$

$\Rightarrow\ (6)^3 = (?)^3$

$\therefore\ ? = 6$

**70.** **(c)** $(4 \times 4)^3 \div (512 \div 8)^4 \times (32 \times 8)^4 = (2 \times 2)^{?+4}$

$\Rightarrow\ (16)^3 \div (64)^4 \times (256)^4 = (4)^{?+4}$

$\Rightarrow\ (4)^{2\times3} \div (4)^{3\times4} \times (4)^{4\times4} = (4)^{?+4}$

$\Rightarrow\ (4)^6 \div (4)^{12} \times (4)^{16} = (4)^{?+4}$

$\Rightarrow\ (4)^{6-2+16} = (4)^{?+4}$

$\Rightarrow\ (4)^{10} = (4)^{?+4}$

$\Rightarrow\ 10 = ? + 4$

$\therefore\ ? = 6$

**71.** **(d)** $\left(2\sqrt{392} - 21\right) + \left(\sqrt{8} - 7\right)^2 = (?)^2$

$\Rightarrow\ \left(2 \times 14\sqrt{2} - 21\right) + \left(\sqrt{8} - 7\right)^2 = (?)^2$

$\Rightarrow\ 28\sqrt{2} - 21 + \left(\sqrt{8}\right)^2 - 2 \times \sqrt{8} \times 7 + (7)^2 = (?)^2$

$\Rightarrow\ 28\sqrt{2} - 21 + 8 - 28\sqrt{2} + 49 = (?)^2$

$\Rightarrow\ -21 + 8 + 49 = (?)^2$

$\Rightarrow\ 36 = (?)^2$

$\therefore\ ? = 6$

**72.** **(a)** $(?)^3 + \sqrt{8} - 340 = (\sqrt{8} \times \sqrt{8})^{\frac{1}{2}} + (9)^{\frac{1}{2}}$

$\Rightarrow\ (?)^3 + \sqrt{8} - 340 = \sqrt{8} + 3$

$\Rightarrow\ (?)^3 = \sqrt{8} + 3 - \sqrt{8} + 340$

$\Rightarrow\ (?)^3 = 343$

$\Rightarrow\ ? = \sqrt[3]{343}$

$\Rightarrow\ ? = 7$

**73.** **(c)** Suppose, that first number = $x$

and the second number = $y$

Then,

$8^2 - y^2 = 15$

$\Rightarrow\ 64 - y^2 = 15$

$\Rightarrow\ y^2 = 49$

$\Rightarrow\ y = \sqrt{49} = 7$

Again,

$x^2 + y^3 = 568$

$\Rightarrow\ x^2 + 7^3 = 568$ (on putting value $y = 7$)

$\Rightarrow\ x^2 + 343 = 568$

$\Rightarrow\ x^2 = 225$

$\Rightarrow\ x = \sqrt{225} = 15$

Hence, $\dfrac{3}{5}$ of the first number

$= \dfrac{3}{5} \times 15$

$= 9$

**74.** **(d)** $(?)^3 = 729$

$(?)^3 = (9)^3$

$? = 9$

**75.** **(d)** $? = \sqrt{2809} = \sqrt{53 \times 53} = 53$

**76.** **(a)** $(2+\sqrt{2}) + \dfrac{1}{(2+\sqrt{2})} + \dfrac{1}{(2-\sqrt{2})}$

$= \dfrac{2(2+\sqrt{2}) + (2-\sqrt{2}) + (2+\sqrt{2})}{(2+\sqrt{2})(2-\sqrt{2})}$

$= \dfrac{2(2+\sqrt{2}) + 4}{2}$

$= (2+\sqrt{2}) + 2$

$= 4 + \sqrt{2}$

**77.** **(a)** $\sqrt{0.09} = 0.3$

**78.** **(a)** $\sqrt{1 + \dfrac{x}{961}} = \dfrac{31}{32}$

On squaring both the sides, we get

$\Rightarrow\ 1 + \dfrac{x}{961} = \left(\dfrac{32}{31}\right)^2$

$\Rightarrow\ 1 + \dfrac{x}{961} = \dfrac{1024}{961},$

$\Rightarrow \quad \frac{x}{961} = \frac{1024}{961} - 1$

$\Rightarrow \quad \frac{x}{961} = \frac{1024}{961} - 961$

$\Rightarrow \quad \frac{x}{961} = \frac{63}{961}$

$\Rightarrow \quad 961x = 63 \times 961$

$\Rightarrow \quad x = \frac{63 \times 961}{961} = 63$

**79.** **(b)** $\sqrt{1 + \frac{x}{9}} = \frac{13}{3}$

On squaring both the sides, we get

$1 + \frac{x}{9} = \frac{169}{9}$

$\Rightarrow \quad \frac{x}{9} = \frac{169 - 9}{9} = \frac{160}{9}$

$\Rightarrow \quad x = \frac{160}{9} \times 9 = 160$

**80.** **(d)** L.H.S. $= \frac{4\sqrt{3} + 5\sqrt{2}}{\sqrt{48} + \sqrt{18}}$

$= \frac{4\sqrt{3} + 5\sqrt{2}}{4\sqrt{3} + 3\sqrt{2}}$

On rationalizing the denominators,

$= \frac{4\sqrt{3} + 5\sqrt{2}}{4\sqrt{3} + 3\sqrt{2}} \times \frac{4\sqrt{3} - 3\sqrt{2}}{4\sqrt{3} - 3\sqrt{2}}$

$= \frac{16 \times 3 - 12\sqrt{6} + 20\sqrt{6} - 15 \times 2}{(4\sqrt{3})^2 - (3\sqrt{2})^2}$

$= \frac{48 + 8\sqrt{6} - 30}{48 - 18}$

$= \frac{48 + 8\sqrt{6}}{30} = \frac{9}{15} + \frac{4\sqrt{6}}{15}$

$= \frac{3}{5} + \frac{4\sqrt{6}}{15}$

Therefore,

$= \frac{3}{5} + \frac{4\sqrt{6}}{15}$

$= a + b\sqrt{6}$

$\Rightarrow \quad a = \frac{3}{5}$ and $b = \frac{4}{15}$

**81.** **(a)** $a = 64$ and $b = 289$

$\therefore \quad \sqrt{a} = \sqrt{64} = 8$ and $\sqrt{b} = \sqrt{289} = 17$

$\therefore \quad \left(\sqrt{\sqrt{a} + \sqrt{b}} - \sqrt{\sqrt{b} - \sqrt{a}}\right)^{\frac{1}{2}}$

$= \left(\sqrt{8 + 17} - \sqrt{17 - 8}\right)^{\frac{1}{2}}$

$= \left(\sqrt{25} - \sqrt{9}\right)^{\frac{1}{2}} = (5 - 3)^{\frac{1}{2}} = (2)^{\frac{1}{2}}$

**82.** **(c)** $\sqrt{x} = \sqrt{3} - \sqrt{5}$

On squaring both sides, we have

$x = 3 + 5 - 2\sqrt{15}$

$\Rightarrow x - 8 = -2\sqrt{15}$

Squaring again, we have

$x^2 - 16x + 64 = 60$

$\Rightarrow \quad x^2 - 16x + 4 = 0$

$\therefore \quad x^2 - 16x + 6 = 2$

**83.** **(b)** $2.\sqrt[3]{40} = 2.\sqrt[3]{2 \times 2 \times 2 \times 5} = 4\sqrt[3]{5}$

$4.\sqrt[3]{320} = 4.\sqrt[3]{2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 5}$

$= 16.\sqrt[3]{5}$

$3.\sqrt[3]{625} = 3.\sqrt[3]{5 \times 5 \times 5 \times 5} = 15.\sqrt[3]{5}$

$\therefore \quad \text{Expression} = 4.\sqrt[3]{5} - 16\sqrt[3]{5} + 15.\sqrt[3]{5} - 3.\sqrt[3]{5}$

$= 19.\sqrt[3]{5} - 19\sqrt[3]{5} = 0$

**84.** **(b)** Given expression

$= \frac{(0.75)^3}{(1 - 0.75)} + [0.75 + (0.75)^2 + 1]$

$= \frac{(0.75)^3 + (1 - 0.75)[(0.75)^2 + 0.75 \times 1 + 1^2]}{1 - 0.75}$

$= \frac{(0.75)^3 + 1^3 - (0.75)^3}{0.25} \quad \left[\begin{array}{l} \because \ (a-b)(a^2 + ab + b^2) \\ = a^3 - b^3 \end{array}\right]$

$= \frac{1}{0.25} = \frac{100}{25} = 4$

$\therefore \quad \text{Required square root} = \sqrt{4} = 2$

**85.** **(b)** $\sqrt{4096} = 64$

$\therefore \quad \sqrt{40.96} = \sqrt{\frac{4096}{100}} = \frac{64}{10} = 6.4$ and

$\sqrt{0.004096} = \sqrt{\frac{4096}{1000000}} = \frac{64}{1000} = 0.064$

$\therefore \quad$ expression $= 64 + 6.4 + 0.064 = 70.464$

**86.** **(d)** $\because \quad a^2 = 2 \quad \Rightarrow a = \sqrt{2}$

$\therefore \quad a + 1 = \sqrt{2} + 1$

$= (\sqrt{2} + 1) \times \frac{(\sqrt{2} - 1)^2}{(\sqrt{2} - 1)^2}$

$= \frac{[(\sqrt{2} + 1) \times (\sqrt{2} - 1)](\sqrt{2} - 1)}{2 + 1 - 2\sqrt{2}}$

$= \frac{\sqrt{2} - 1}{3 - 2\sqrt{2}} = \frac{a - 1}{3 - 2a}$

**87.** **(b)** Expression $= \frac{(0.75)^3}{1 - 0.75} + [0.75 + (0.75)^2 + 1]$

Let, $0.75 = a$

Now, expression becomes $= \dfrac{a^3}{1-a} + (a + a^2 + 1)$

[Here, $1 - a^3 = (1 - a) = (a^2 + a + 1)$

and, $a^2 + a + 1 = \dfrac{1-a^3}{1-a}$ ]

$\therefore$ Expression $= \dfrac{a^3}{(1-a)} + \dfrac{1-a^3}{(1-a)} = \dfrac{1}{1-a}$

$= \dfrac{1}{1-0.75} = \dfrac{1}{1-3/4} = 4$

Again, required square root $= \sqrt{4} = 2$

**88.** **(c)** The given expression $= \sqrt[3]{(13.608)^2 - (13.392)^2}$

$= \sqrt[3]{(13.608 + 13.392) \times (13.608 - 13.392)}$

$= \sqrt[3]{27 \times (.216)} = \sqrt[3]{3^3 \times (0.6)^3}$

$= 3 \times 0.6 = 1.8$

**89.** **(a)** $\dfrac{9.5 \times 0.0085 \times 18.9}{0.0017 \times 1.9 \times 2.1} = \dfrac{95 \times 85 \times 189}{17 \times 19 \times 21}$

$= 5 \times 5 \times 9 = 225$

$\therefore$ Required square root $= \sqrt{225} = 15$

**90.** **(b)** Note that in these types of surds, the largest surd is $\left(\sqrt{5} - \sqrt{3}\right)$ because it has small numbers but biggest difference between them. (Always remember)

$\therefore \sqrt{3} - \sqrt{1} > \sqrt{5} - \sqrt{3} > \sqrt{7} - \sqrt{5} > \sqrt{9} - \sqrt{7} > \sqrt{11} - \sqrt{9}$

**91.** **(a)** $? = \sqrt{1000000.000001} \approx \sqrt{1000 \times 1000} = 1000$

**92.** **(a)** $? = \left[\left(5\sqrt{7} + \sqrt{7}\right) \times \left(4\sqrt{7} + 8\sqrt{7}\right)\right] - (19)^2$

$= [20 \times 7 + 4 \times 7 + 8 \times 7 + 40 \times 7] - 361$

$= [140 + 28 + 56 + 280] - 361$

$= 504 - 361 = 143$

**93.** **(e)** or, $38 \times 37.8 = (?)^2$ $\quad (\therefore\ 37.8 \approx 38)$

or, $38 \times 38 = (?)^2$

$\therefore \quad ? = \sqrt{38 \times 38} = 38$

or, $(?)^2 + (37)^2 = 182 \times 51 - (83)^2$

or, $(?)^2 + 1369 = 9282 - 6889 = 2393$

or, $(?)^2 = 2393 - 1369 = 1024$

$\therefore \quad ? = \sqrt{1024} = 32$

**94.** **(c)** $? = 8787 \div 343 \times \sqrt{50}$

$= 25.61 \times 7.07 = 181.09 \approx 180$

**95.** **(b)** $\sqrt[3]{54881} \times (303 \div 8) = (?)^2$

or, $38 \times 37.8 = (?)^2$ $\quad (\therefore\ 37.8 \approx 38)$

or, $38 \times 38 = (?)^2$

$\therefore \quad ? = \sqrt{38 \times 38} = 38$

**96.** **(c)** $[\sqrt{8}(3+1) \times \sqrt{8}(8+7)] - 98$

$= [4\sqrt{8} \times 15 \times \sqrt{8}] - 98$

$= [60 \times 8] - 98 = 480 - 98 = 382$

**97.** **(b)** $\sqrt{11449} \times \sqrt{6241} - (54)^2 - (74)^2 = \sqrt{?}$

or, $\sqrt{?} = [107 \times 79] - 2916 - 5476$

$= 8453 - 2916 - 5476 = 61$

or, $? = (61)^2 = 3721$

**98.** **(b)** $\sqrt{6354} \times 34.993 = 80 \times 35 = 2800$

**99.** **(e)** $17 + 349 = ? \div 21$

or, $366 \times 21 = ?$

or, $? = 7686 \approx 7680.$

**100.** **(d)** $(15)^2 \times \sqrt{730} = 225 \times 27 = 6075$

**101.** **(c)** $? = 73.86 \times 46.04 \div 21.44$

$\Rightarrow \quad ? = 74 \times 46 \div 22$

$\Rightarrow \quad ? = 154.7 \approx 160$

**102.** **(e)**

**I.** $\sqrt{25x^2} - 125 = 0$

$\Rightarrow \quad \sqrt{25x^2} = 125$

$\Rightarrow \quad x^2 = \dfrac{125 \times 125}{25} = 625$

$\therefore \quad x = \sqrt{625} = \pm 25$

**II.** $\sqrt{361}y + 95 = 0$

$\Rightarrow \quad 19y = -95$

$\Rightarrow \quad y = -5$

Hence, relationship between $x$ and $y$ cannot be established.

**103.** **(c)**

**I.** $\dfrac{5}{7} - \dfrac{5}{21} = \dfrac{\sqrt{x}}{42}$

$\Rightarrow \quad \dfrac{15-5}{21} = \dfrac{\sqrt{x}}{42}$

$\Rightarrow \quad \sqrt{x} = \dfrac{10}{21} \times 42 = 20$

$\therefore \quad x = 20 \times 20 = 400$

**II.** $\dfrac{\sqrt{y}}{4} + \dfrac{\sqrt{y}}{16} = \dfrac{250}{\sqrt{y}}$

$\Rightarrow \quad \dfrac{4\sqrt{y} + \sqrt{y}}{16} = \dfrac{250}{\sqrt{y}}$

$\Rightarrow \quad 5\sqrt{y} \times \sqrt{y} = 250 \times 16$

$\Rightarrow \quad y = \dfrac{250 \times 16}{5} = 800$

Hence, $y > x$.

**104.** **(a)**

**I.** $(625)^{\frac{1}{4}}x + \sqrt{1225} = 155$

$\Rightarrow \quad (5^4)^{\frac{1}{4}}x + 35 = 155$

$\Rightarrow \quad 5x = 155 - 35$

$\Rightarrow \quad 5x = 120$

$\Rightarrow \quad x = \dfrac{120}{5} = 24$

**II.** $\sqrt{196}y + 13 = 279$

$\Rightarrow \quad 14y = 279 - 13 = 266$

$\Rightarrow \quad y = \dfrac{266}{14} = 19$

Hence, $x > y$.

**105. (a)**

**I.** $5x^2 - 18x + 9 = 0$

$\Rightarrow \quad 5x^2 - 15x - 3x + 9 = 0$

$\Rightarrow \quad 5x(x-3) - 3(x-3) = 0$

$\Rightarrow \quad (5x-3)(x-3)$

$\Rightarrow \quad x = \dfrac{3}{5}$ or 3

**II.** $3y^2 + 5y - 2 = 0$

$\Rightarrow \quad 3y^2 + 6y - y - 2 = 0$

$\Rightarrow \quad 3y(y+2) - 1(y+2) = 0$

$\Rightarrow \quad (3y-1)(y+2) = 0$

$\Rightarrow \quad y = \dfrac{1}{3}$ or $-2$

Hence, $x > y$.

**106. (c)**

**I.** $\dfrac{13}{\sqrt{x}} + \dfrac{9}{\sqrt{x}} = \sqrt{x}$

$\Rightarrow \quad 13 + 9 = \sqrt{x} \times \sqrt{x} = x$

$\Rightarrow \quad x = 22$

**II.** $y^4 - \dfrac{(13 \times 2)^{\frac{9}{2}}}{\sqrt{y}} = 0$

$\Rightarrow \quad y^{\frac{9}{2}} = (26)^{\frac{9}{2}}$

$\Rightarrow \quad y = 26$

Hence, $x < y$.

**107. (e)** $\sqrt{25 \times 14 - 42 + (4)^?} = 18$

$\Rightarrow (4)^? = (18)^2 - 308$

$\Rightarrow (4)^? = 324 - 308 = 16$

$\Rightarrow ? = 2$

# Simplification

# 4

## SIMPLE ARITHMETIC OPERATIONS

It is a common need to simplify the expressions formulated according to the statements of the problems related to practical life. To do this, it is essential to follow in sequence the mathematical operations given by the term, 'BODMAS'.

> **BODMAS**
>
> Each letter of the word BODMAS stands as follows:
>
> B for Bracket : [{(–)}]
>
> There are four brackets, namely, – i.e., bar, ( ), { } and [ ]. They are removed, strictly in the order –, ( ), { } and [ ].
>
> O for Of : of
>
> D for Division : ÷
>
> M for Multiplication : ×
>
> A for Addition : +
>
> S for Subtraction : –
>
> The order of various operations in exercises involving brackets and fractions must be strictly performed according to the order of the letters of the word BODMAS.

***Note:***

Here, $-\overline{5-8} = -(-3) = 3$.

**Illustration 1:** Simplify

$$8\frac{1}{2}-\left[3\frac{1}{5}\div 4\frac{1}{2}\text{ of }5\frac{1}{3}+\left\{11-\left(3-1\overline{\frac{1}{4}-\frac{5}{8}}\right)\right\}\right]$$

**Solution:** Given expression

$$=\frac{17}{2}-\left[\frac{16}{5}\div\frac{9}{2}\text{ of }\frac{16}{3}+\left\{11-\left(3-\overline{\frac{5}{4}-\frac{5}{8}}\right)\right\}\right]$$

$$=\frac{17}{2}-\left[\frac{16}{5}\div\frac{9}{2}\text{ of }\frac{16}{3}+\left\{11-\left(3-\frac{5}{8}\right)\right\}\right]$$

$$=\frac{17}{2}-\left[\frac{16}{5}\div\frac{9}{2}\text{ of }\frac{16}{3}+\left\{11-\frac{19}{8}\right\}\right]$$

$$=\frac{17}{2}-\left[\frac{16}{5}\div\frac{9}{2}\text{ of }\frac{16}{3}+\frac{69}{8}\right]$$

$$=\frac{17}{2}-\left[\frac{16}{5}\div\frac{9}{2}\times\frac{16}{3}+\frac{69}{8}\right]$$

$$=\frac{17}{2}-\left[\frac{16}{5}\div\frac{24}{1}+\frac{69}{8}\right]$$

$$=\frac{17}{2}-\left[\frac{16}{5}\times\frac{1}{24}+\frac{69}{8}\right]=\frac{17}{2}-\left[\frac{16}{120}+\frac{69}{8}\right]$$

$$=\frac{17}{2}-\left[\frac{16+1035}{120}\right]=\frac{17}{2}-\frac{1051}{120}$$

$$=\frac{1020-1051}{120}=-\frac{31}{120}.$$

**Illustration 2:** Simplify

$$5\frac{1}{3}-\left\{4\frac{1}{3}-\left(3\frac{1}{3}-\overline{2\frac{1}{3}-\frac{1}{3}}\right)\right\}$$

**Solution:** Given expression

$$=\frac{16}{3}-\left\{\frac{13}{3}-\left(\frac{10}{3}-\overline{\frac{7}{3}-\frac{1}{3}}\right)\right\}$$

$$=\frac{16}{3}-\left\{\frac{13}{3}-\left(\frac{10}{3}-\frac{6}{3}\right)\right\}=\frac{16}{3}-\left\{\frac{13}{3}-\frac{4}{3}\right\}$$

$$=\frac{16}{3}-\left\{\frac{9}{3}\right\}=\frac{16}{3}-\frac{9}{3}=\frac{7}{3}=2\frac{1}{3}.$$

### Use of Algebraic Formulae

The following formulae are sometimes found useful in dealing with the simplifications:

1. $(a + b)^2 = a^2 + 2ab + b^2$
2. $(a - b)^2 = a^2 - 2ab + b^2$
3. $(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$
4. $(a + b)^2 - (a - b)^2 = 4ab$
5. $a^2 - b^2 = (a + b)(a - b)$
6. $(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$
   $= a^3 + b^3 + 3ab(a + b)$
7. $(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$
   $= a^3 - b^3 - 3ab(a - b)$
8. $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$
9. $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
10. $\dfrac{a^3+b^3+c^3-3abc}{a^2+b^2+c^2-ab-bc-ca} = (a + b + c)$.
11. $a^4 - a^4 = (a^2 + b^2)(a + b)(a - b)$.

**Illustration 3:** Simplify the following
(i) $0.32 \times 0.32 + 0.64 \times 0.68 + 0.68 \times 0.68$

**Solution:** Given expression
$= 0.32 \times 0.32 + 2 \times 0.32 \times 0.68 + 0.68 \times 0.68$
$= (0.32)^2 + 2 \times 0.32 \times 0.68 + (0.68)^2$
$= (0.32 + 0.68)^2 \quad [\because a^2 + 2ab + b^2 = (a + b)^2]$
$= 1^2 = 1.$

(ii) $2.45 \times 2.45 - 0.9 \times 2.45 + 0.45 \times 0.45$

**Solution:** Given expression
$= 2.45 \times 2.45 - 2 \times 2.45 \times 0.45 + 0.45 \times 0.45$
$= (2.45)^2 - 2 \times 2.45 \times 0.45 + (0.45)^2$
$= (2.45 - 0.45)^2 \quad [\because a^2 - 2ab + b^2 = (a - b)^2]$
$= (2)^2 = 4.$

(iii) $\dfrac{7\times\{(146+92)^2+(146-92)^2\}}{(146)^2+(92)^2}$

**Solution:** Given expression

$$= \frac{7\times 2\{(146)^2+(92)^2\}}{(146)^2+(92)^2}$$
$[\because (a + b)^2 + (a - b)^2 = 2(a^2 + b^2)]$
$= 14.$

(iv) $\dfrac{(0.345+0.255)^2-(0.345-0.255)^2}{0.345\times 1.02}$

**Solution:** Given expression
$$= \frac{(0.345+0.255)^2-(0.345-0.255)^2}{4\times 0.345\times 0.255}$$
$$= \frac{4\times 0.345\times 0.255}{4\times 0.345\times 0.255} \quad [\because (a + b)^2 - (a - b)^2 = 4ab]$$
$= 1.$

(v) $\dfrac{0.682\times 0.682-0.318\times 0.318}{0.682-0.318}$

**Solution:** Given expression
$$= \frac{(0.682)^2-(0.318)^2}{0.682-0.318}$$
$= (0.682 + 0.318) \quad \left[\because \dfrac{a^2-b^2}{a-b} = a+b\right]$
$= 1.$

(vi) $\dfrac{(3.29)^2-(0.81)^2}{4}$

**Solution:** Given expression
$$= \frac{(3.29)^2-(0.81)^2}{3.29+0.81}$$
$= (3.29 - 0.81) \quad \left[\because \dfrac{a^2-b^2}{a+b} = a-b\right]$
$= 2.48.$

(vii) $(2.35)^3 + 1.95 \times (2.35)^2 + 7.05 \times (0.65)^2 + (0.65)^3$

**Solution:** Given expression
$= (2.35)^3 + 3 \times 0.65 \times (2.35)^2$
$+ 3 \times 2.35 \times (0.65)^2 + (0.65)^3$
$= (2.35 + 0.65)^3$
$[\because a^3 + 3a^2b + 3ab^2 + b^3 = (a + b)^3]$
$= (3)^3 = 27.$

(viii) $\dfrac{(4.32)^3-0.96\times(4.32)^2+12.96\times(0.32)^2-(0.32)^3}{4\times 4\times 4}$

**Solution:** Given expression
$$= \frac{(4.32)^3-3\times 0.32\times(4.32)^2+3\times 4.32\times(0.32)^2-(0.32)^3}{4\times 4\times 4}$$
$$= \frac{(4.32-0.32)^3}{4^3} \quad [\because a^3 - 3a^2b + 3ab^2 - b^3 = (a - b)^3]$$
$$= \left(\frac{4}{4}\right)^3 = 1.$$

(ix) $\dfrac{885\times 885\times 885+115\times 115\times 115}{885\times 885+115\times 115-885\times 115}$

**Solution:** Given expression
$$= \frac{(885)^3+(115)^3}{(885)^2+(115)^2-885\times 115}$$

$= (885 + 115)$ $\left[\because \dfrac{a^3+b^3}{a^2-ab+b^2} = a+b\right]$

$= 1000.$

(x) $\dfrac{0.62\times 0.62\times 0.62 - 0.41\times 0.41\times 0.41}{0.62\times 0.62 + 0.62\times 0.41 + 0.41 + 0.41}$

**Solution:** Given expression

$$= \frac{(0.62)^3 - (0.41)^3}{(0.62)^2 + 0.62\times 0.41 + (0.41)^2}$$

$= (0.62 - 0.41)$ $\left[\because \dfrac{a^3-b^3}{a^2+ab+b^2} = a-b\right]$

$= 0.21.$

(xi) $\dfrac{(2.3)^3 + (1.5)^3 + (1.2)^3 - 3\times 2.3\times 1.5\times 1.2}{2.3\times 2.3 + 1.5\times 1.5 + 1.2\times 1.2 - 2.3\times 1.5 - 2.3\times 1.2 - 1.5\times 1.2}$

**Solution:** Given expression

$$= \frac{(2.3)^3 + (1.5)^3 + (1.2)^3 - 3\times 2.3\times 1.5\times 1.2}{(2.3)^2 + (1.5)^2 + (1.2)^2 - 2.3\times 1.5 - 2.3\times 1.2 - 1.5\times 1.2}$$

$= (2.3 + 1.5 + 1.2)$

$\left[\because \dfrac{a^3+b^3+c^3-3abc}{a^2+b^2+c^2-ab-ac-bc} = a+b+c\right]$

$= 5.$

### Surds and Indices

$a^n$ is called, 'a **surd**' if $n$ is a fraction and $a^n$ is called, 'an **index**' if $n$ is an integer. $a$ is called, 'the **base**'.

## SOME USEFUL SHORT-CUT METHODS

1. $a^m \times a^n = a^{m+n}$
2. $a^m \div a^n = a^{m-n}$
3. $(a^m)^n = (a^n)^m = a^{mn}$
4. $\left(\dfrac{a}{b}\right)^{-\frac{m}{n}} = \left(\dfrac{b}{a}\right)^{\frac{m}{n}}$
5. $a^m \div b^{-n} = a^m \times b^n$
6. $(\sqrt[n]{a})^n = a$, where '$n$' is a +ve integer and '$a$' a +ve rational number.
7. $\sqrt[n]{a}\,\sqrt[n]{b} = \sqrt[n]{ab}$, where '$n$' is a +ve integer and '$a$', '$b$' are rational numbers.
8. $\dfrac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\dfrac{a}{b}}$, where '$n$' is a +ve integer and '$a$', '$b$' are rational numbers.
9. $\sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a} = \sqrt[n]{\sqrt[m]{a}}$, where '$m$', '$n$' are +ve integers and '$a$' is a +ve rational number.
10. $\sqrt[n]{\sqrt[m]{(a^k)^m}} = \sqrt[n]{a^k} = \sqrt[mn]{a^{km}}$, where '$m$', '$n$', '$k$' are +ve integers and '$a$' is a +ve rational number.
11. $\sqrt{a}\times\sqrt{a} = a$
12. $\sqrt{a}\times\sqrt{b} = \sqrt{ab}$
13. $(\sqrt{a}+\sqrt{b})^2 = a + b + 2\sqrt{ab}$
14. $(\sqrt{a}-\sqrt{b})^2 = a + b - 2\sqrt{ab}$
15. $a + \sqrt{b} = c + \sqrt{d} \Rightarrow a = c$ and $b = d$.
16. $\dfrac{1}{\sqrt{a}-\sqrt{b}} = \dfrac{\sqrt{a}+\sqrt{b}}{(\sqrt{a}-\sqrt{b})(\sqrt{a}+\sqrt{b})} = \dfrac{\sqrt{a}+\sqrt{b}}{a-b}$
17. $\dfrac{1}{\sqrt{a}+\sqrt{b}} = \dfrac{\sqrt{a}-\sqrt{b}}{(\sqrt{a}+\sqrt{b})(\sqrt{a}-\sqrt{b})} = \dfrac{\sqrt{a}-\sqrt{b}}{a-b}$
18. If $x = n(n + 1)$, then

    (a) $\sqrt{x-\sqrt{x-\sqrt{x-\ldots\infty}}} = n$ and

    (b) $\sqrt{x+\sqrt{x+\sqrt{x+\ldots\infty}}} = (n + 1)$

**Illustration 4:** Find the value of $(243)^{0.8} \div (243)^{0.4}$.

**Solution:** $(243)^{0.8} \div (243)^{0.4} = (243)^{0.8-0.4}$

$[\because a^m \div a^n = a^{m-n}]$

$= (243)^{0.4}$

$= (3^5)^{\frac{2}{5}} = 3^2 = 9.$

**Illustration 5:** Find the value of $(27)^{2/3} \div (64)^{-4/3}$

**Solution:** $(27)^{2/3} \div (64)^{-4/3} = (3^3)^{2/3} \times (64)^{4/3}$

$[\because a^m \div b^{-n} = a^m \times b^n]$

$= 3^2 \times (4^3)^{4/3}$

$= 9 \times (4^4) = 9 \times 256 = 2304.$

**Illustration 6:** Find the value of $(-3)^{(-2)^{(-2)^{(-4)}}}$

**Solution:** $(-3)^{(-2)^{(-2)^{(-4)}}} = \left(-\dfrac{1}{3}\right)^{(2)^{(-2)^{(-4)}}} = \left(\dfrac{1}{9}\right)^{(-2)^{(-4)}}$

$= (9)^{(2)^{(-4)}}$

$$= (81)^{-4} = \left(\frac{1}{81}\right)^4$$

$$= \left(\frac{1}{3^4}\right)^4 = \frac{1}{3}.$$

**Illustration 7:** Find the value of $x$ if $\sqrt[5]{2x-7} - 3 = 0$.

**Solution:** We have

$$\sqrt[5]{2x-7} - 3 = 0 \Rightarrow \sqrt[5]{2x-7} = 3$$

$$\Rightarrow (\sqrt[5]{2x-7})^5 = 3^5$$

$$\Rightarrow 2x - 7 = 243 \quad [\because (\sqrt[n]{a})^n = a]$$

$$\Rightarrow 2x = 250 \text{ or, } x = 125.$$

**Illustration 8:** Find the value of $\sqrt[5]{64} \times \sqrt[5]{512}$.

**Solution:** $\sqrt[5]{64} \times \sqrt[5]{512}$

$$= \sqrt[5]{64 \times 512} \quad [\because \sqrt[n]{a} \times \sqrt[n]{b} = \sqrt[n]{ab}]$$

$$= \sqrt[5]{8^2 \times 8^3} = \sqrt[5]{8^5} = 8. \quad [\because \sqrt[n]{a^n} = a]$$

**Illustration 9:** Find the value of $\sqrt[3]{\sqrt[2]{729}}$.

**Solution:** $\sqrt[3]{\sqrt[2]{729}} = \sqrt[6]{729} \quad [\because \sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a}]$

$$= \sqrt[6]{3^6} = 3. \quad [\because \sqrt[n]{a^n} = a]$$

**Illustration 10:** Find the value of $\dfrac{\sqrt[7]{\sqrt[5]{(21^7)^5}}}{\sqrt[5]{\sqrt[3]{(7^5)^3}}}$.

**Solution:** Given expression

$$= \frac{\sqrt[7]{(21)^7}}{\sqrt[5]{(7)^5}} \quad \left[\because \sqrt[n]{\sqrt[m]{(a^p)^m}} = \sqrt[n]{a^p}\right]$$

$$= \frac{21}{7} = 3. \quad [\because \sqrt[n]{a^n} = a]$$

**Illustration 11:** Find the value of $\sqrt{5} \times \sqrt{125}$.

**Solution:** $\sqrt{5} \times \sqrt{125} = \sqrt{625} \quad [\because \sqrt{a} \times \sqrt{b} = \sqrt{ab}]$

$$= 25.$$

**Illustration 12:** Simplify each of the following by rationalizing the denominators.

(i) $\dfrac{1}{2+\sqrt{3}}$ (ii) $\dfrac{7\sqrt{3}-5\sqrt{2}}{\sqrt{48}+\sqrt{18}}$

**Solution:** (i) $\dfrac{1}{2+\sqrt{3}} = \dfrac{1}{2+\sqrt{3}} \times \dfrac{2-\sqrt{3}}{2-\sqrt{3}}$

$$= \frac{2-\sqrt{3}}{(2)^2-(\sqrt{3})^2}$$

$$= \frac{2-\sqrt{3}}{4-3} = 2-\sqrt{3}.$$

(ii) $\dfrac{7\sqrt{3}-5\sqrt{2}}{\sqrt{48}+\sqrt{18}} = \dfrac{7\sqrt{3}-5\sqrt{2}}{\sqrt{4^2\times 3}+\sqrt{3^2\times 2}}$

$$= \frac{7\sqrt{3}-5\sqrt{2}}{4\sqrt{3}+3\sqrt{2}} = \frac{7\sqrt{3}-5\sqrt{2}}{4\sqrt{3}+3\sqrt{2}} \times \frac{4\sqrt{3}-3\sqrt{2}}{4\sqrt{3}-3\sqrt{2}}$$

$$= \frac{(7\sqrt{3}-5\sqrt{2})(4\sqrt{3}-3\sqrt{2})}{(4\sqrt{3}+3\sqrt{2})(4\sqrt{3}-3\sqrt{2})}$$

$$= \frac{7\sqrt{3}\times 4\sqrt{3} - 7\sqrt{3}\times 3\sqrt{2} - 5\sqrt{2}\times 4\sqrt{3} + 5\sqrt{2}\times 3\sqrt{2}}{(4\sqrt{3})^2-(3\sqrt{2})^2}$$

$$= \frac{28\sqrt{3\times 3} - 21\sqrt{3\times 2} - 20\sqrt{2\times 3} + 15\sqrt{2\times 2}}{16\times 3 - 9\times 2}$$

$$= \frac{28\times 3 - 21\times\sqrt{6} - 20\sqrt{6} + 15\times 2}{48-18}$$

$$= \frac{84-(21\times 20)\sqrt{6}+30}{30} = \frac{114-41\sqrt{6}}{30}$$

**Illustration 13:** If $a$ and $b$ are rational numbers, find the values of $a$ and $b$ in the following equation.

$$\frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} = a+b\sqrt{6}.$$

**Solution:** $\dfrac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} = \dfrac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} \times \dfrac{\sqrt{3}+\sqrt{2}}{\sqrt{3}+\sqrt{2}}$

$$= \frac{(\sqrt{3}+\sqrt{2})^2}{(\sqrt{3})^2-(\sqrt{2})^2}$$

$$= \frac{3+2+2\sqrt{3}\times\sqrt{2}}{3-2} = \frac{5+2\sqrt{6}}{1}$$

$$= 5 + 2\sqrt{6}$$

$$\therefore \quad \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} = a + b\sqrt{6} \Rightarrow 5 + 2\sqrt{6} = a + b\sqrt{6}.$$

On equating rational and irrational parts, we get

$a = 5$ and $b = 2$.

**Illustration 14:** Find the value of

$$\left(\sqrt{72+\sqrt{72+\sqrt{72+\ldots\infty}}}\right) \div \left(\sqrt{12-\sqrt{12-\sqrt{12-\ldots\infty}}}\right)$$

**Solution:** Since $72 = 9 \times 8$,

therefore, $72 + \sqrt{72+\sqrt{72+\ldots\infty}} = 9$

Also, since $12 = 4 \times 3$

therefore, $\sqrt{12-\sqrt{12-\sqrt{12-\ldots\infty}}} = 3$.

Thus, the given expression $= \dfrac{9}{3} = 3$.

## Fractions

### 1. Continued Fraction

Fractions of the form $7+\cfrac{2}{5+\cfrac{3}{4+\cfrac{2}{3+\cfrac{1}{4}}}}$

are called, 'continued fractions'.

To simplify a continued fraction, we start from the bottom and work upwards.

**Illustration 15:** Simplify $3-\cfrac{1}{4+\cfrac{7}{9-\cfrac{5}{6+\cfrac{2}{3}}}}$.

**Solution:** $3-\cfrac{1}{4+\cfrac{7}{9-\cfrac{5}{6+\cfrac{2}{3}}}}=3-\cfrac{1}{4+\cfrac{7}{9-\cfrac{15}{20}}}$

$\left[\text{Multiply the numerator and denominator of the lowest term } \dfrac{5}{\left(6+\dfrac{2}{5}\right)} \text{ by 3 to get } \dfrac{15}{20}.\right]$

$=3-\cfrac{1}{4+\cfrac{7}{9-\cfrac{3}{4}}}=3-\cfrac{1}{4+\cfrac{28}{33}}$

$\left[\text{Multiply the numerator and denominator of the lowest term } \dfrac{7}{\left(9-\dfrac{3}{4}\right)} \text{ by 4 to get } \dfrac{28}{33}.\right]$

$= 3 - \dfrac{33}{160}$

$\left[\text{Multiply the numerator and denominator of the term } \dfrac{1}{\left(4+\dfrac{28}{33}\right)} \text{ by 33 to get } \dfrac{33}{160}.\right]$

$=\dfrac{480-33}{160}=\dfrac{447}{160}=2\dfrac{127}{160}$.

### 2. Comparison of Fractions

The following points are found useful while comparing two or more fractions.

> **(a) If the denominators of the fractions are same, the largest is one whose numerator is the largest.**

**Illustration 16:** Which is the largest fraction among the following?

$$\frac{3}{8}, \frac{7}{8} \text{ and } \frac{5}{8}$$

**Solution:** $\dfrac{7}{8}$.

> **(b) If the numerators of the fractions are same, the largest is one whose denominator is the smallest.**

**Illustration 17:** Which is the largest fraction among the following?

$$\frac{5}{2}, \frac{5}{7} \text{ and } \frac{5}{9}$$

**Solution:** $\dfrac{5}{2}$

> **(c) If neither the numerators nor the denominators of the fractions are same, then they are converted into equivalent fractions of the same denominator by taking the L.C.M. of the denominators of the given fractions. Then the fractions are compared according to (1).**

**Illustration 18:** Which is the largest fraction among the following?

$$\frac{1}{2}, \frac{2}{3}, \frac{4}{5} \text{ and } \frac{5}{8}$$

**Solution:** L.C.M. of 2, 3, 5 and 8 = 120.

$$\frac{1}{2}=\frac{1\times 60}{2\times 60}=\frac{60}{120}$$

Then,

$\dfrac{2}{3}=\dfrac{2\times 40}{3\times 40}=\dfrac{80}{120}$

$\dfrac{4}{5}=\dfrac{4\times 24}{5\times 24}=\dfrac{96}{120}$

and, $\dfrac{5}{8}=\dfrac{5\times 15}{8\times 15}=\dfrac{75}{120}$

Now, the denominator of these fractions are same and the largest numerator is 96. Hence, the largest fraction is $\dfrac{96}{1220}$, that is, $\dfrac{4}{5}$.

> **(d) Two fractions can also be compared by cross-multiplication method.**

**Illustration 19:** Which is greater $\frac{6}{13}$ or $\frac{7}{5}$?

**Solution:** **Step 1.** By cross-multipling the two given fractions

$$\frac{6}{13} \times \frac{5}{7},$$

we get $6 \times 7 = 42$ and $13 \times 5 = 65$.

**Step 2.** Since 65 is greater than 42 and in 65, the numerator of $\frac{5}{7}$ is included, $\therefore$ $\frac{5}{7}$ is greater than $\frac{6}{13}$.

(e) If the difference of the numerator and denominator of each of the given fractions be same, then the fraction of the largest numerator is the smallest.

**Illustration 20:** Which of the following fraction is the largest?

$$\frac{2}{3}, \frac{3}{4}, \frac{5}{6} \text{ and } \frac{9}{10}$$

**Solution:** In each of the given fractions, the difference between the numerator and denominator is same and the largest numerator is 9. The largest fraction is $\frac{9}{10}$.

(f) In the given fractions, $\frac{x}{y}, \frac{x+a}{y+b}, \frac{x+2a}{y+2b}, \ldots, \frac{x+na}{y+nb}$, where $a < b$

(a) If $\frac{\text{Increase in Numerator}}{\text{Increase in Denominator}} > \text{first fraction}$, the last value is the greatest.

(b) If $\frac{\text{Increase in Numerator}}{\text{Increase in Denominator}} < \text{first fraction}$, the last value is the least.

(c) If $\frac{\text{Increase in Numerator}}{\text{Increase in Denominator}} = \text{first fraction}$, all values are equal.

**Illustration 21:** Which one the following fractions is the greatest?

$$\frac{3}{8}, \frac{4}{11}, \frac{5}{14}, \frac{6}{17}, \frac{7}{20}.$$

**Solution:** Since, $\frac{\text{increase in numerator}}{\text{increase in denominator}} = \frac{1}{3}$ is less than the first fraction $\frac{3}{8}$, therefore, the first fraction $\frac{3}{8}$ is the greatest.

**Illustration 22:** Which of the following fractions is the least?

$$\frac{2}{5}, \frac{4}{11}, \frac{6}{17}, \frac{8}{23}$$

**Solution:** Since, $\frac{\text{increase in numerator}}{\text{increase in denominator}} = \frac{2}{6} = \frac{1}{3}$ is less than the first fraction $\frac{2}{5}$, therefore, the last fraction $\frac{8}{23}$ is the least.

3. Inserting a fraction between two given fractions.
To insert a fraction between two given fractions $\frac{a_1}{b_1}$ and $\frac{a_2}{b_2}$, the following steps may be useful.

**Step 1** The numerators of the two given fractions are added to get the numerator of the resulting fraction, that is, $a_1 + a_2$.

**Step 2** The denominators of the two given fractions are added to get the denominator of the resulting fraction, that is, $b_1 + b_2$.

**Step 3** The resulting fraction $= \frac{a_1 + a_2}{b_1 + b_2}$.

**Illustration 23:** Insert a fraction between $\frac{2}{5}$ and $\frac{4}{7}$.

**Solution:** By using the given method,

$$\frac{2}{5}, \frac{2+4}{5+7}, \frac{4}{7} = \frac{2}{5}, \frac{6}{12}, \frac{4}{7} \text{ or, } \frac{2}{5}, \frac{1}{2}, \frac{4}{7}.$$

**Illustration 24:** Insert three fractions between $\frac{5}{7}$ and $\frac{9}{11}$.

**Solution:** By using the given method,

$$\frac{5}{7}, \frac{5+9}{7+11}, \frac{9}{11} = \frac{5}{7}, \frac{14}{18}, \frac{9}{11}$$

$$\text{or, } \frac{5}{7}, \frac{7}{9}, \frac{9}{11}.$$

Further,

$$\frac{5}{7}, \frac{5+7}{7+9}, \frac{7}{9}, \frac{7+9}{9+11}, \frac{9}{11} = \frac{5}{7}, \frac{12}{16}, \frac{7}{9}, \frac{16}{20}, \frac{9}{11}$$

$$\text{or } \frac{5}{7}, \frac{3}{4}, \frac{7}{9}, \frac{4}{5}, \frac{9}{11}.$$

Thus, the three fractions inserted between $\frac{5}{7}$ and $\frac{9}{11}$ are $\frac{3}{4}, \frac{7}{9}$ and $\frac{4}{5}$.

## EXERCISE–I

**1.** Simplify:

$$\frac{3}{10}\div\frac{3}{7} \text{ of } \left(2\frac{3}{10}+2\frac{3}{5}\right) + \frac{1}{5} \div 1\frac{2}{5}-\frac{2}{7}$$

(a) 1 (b) 2
(c) 0 (d) 3

**2.** $1+1\div\left\{1+1\div\left(1-\frac{1}{3}\right)\right\}$ = ?

(a) $\frac{7}{5}$ (b) $\frac{2}{3}$
(c) $\frac{4}{5}$ (d) None of these

**3.** $48\div12\times\left(\frac{9}{8} \text{ of } \frac{4}{3}+\frac{3}{4} \text{ of } \frac{2}{3}\right)$ = ?

(a) 9 (b) 12
(c) 15 (d) None of these

**4.** Simplify:

2 ÷ [2 + 2 ÷ {2 + 2 ÷ (2 + 2 ÷ 3)}]

(a) 13/15 (b) 17/15
(c) 11/15 (d) None of these

**5.** $7\frac{1}{2}-\left[2\frac{1}{4}\div\left\{1\frac{1}{4}-?\left(1\frac{1}{2}-\frac{1}{3}-\frac{1}{6}\right)\right\}\right] = 3$

(a) $\frac{1}{4}$ (b) $\frac{3}{4}$
(c) $\frac{4}{3}$ (d) None of these

**6.** The simplification of $\frac{0.8\times0.8\times0.8-0.5\times0.5\times0.5}{0.8\times0.8+0.8\times0.5+0.5\times0.5}$ gives:

(a) 0.8 (b) 0.4
(c) 0.3 (d) 0.13

**7.** The simplification of $\left[\frac{1}{2}+\frac{1}{2}\left\{\frac{3}{4}-\frac{1}{2}\left(\frac{7}{8}-\frac{3}{4}\right)\right\}\right]$ yields:

(a) $\frac{27}{16}$ (b) $\frac{27}{32}$
(c) $\frac{27}{64}$ (d) $\frac{107}{112}$

**8.** Simplify: $1 - [2 - \{5 - (4 - \overline{3-2})\}]$

(a) 1 (b) 2
(c) 3 (d) 4

**9.** $3 \div \left[(8-5)\div\left\{(4-2)\div\left(2+\frac{8}{13}\right)\right\}\right]$ = ?

(a) $\frac{33}{71}$ (b) $\frac{55}{17}$
(c) $\frac{13}{17}$ (d) None of these

**10.** $\frac{69842\times69842-30158\times30158}{69842-30158}$ = ?

(a) 100000 (b) 69842
(c) 39684 (d) 30158

**11.** Simplify $\frac{2\frac{1}{7}-2\frac{1}{2}}{2\frac{1}{4}+1\frac{1}{7}}\div\cfrac{1}{2+\cfrac{1}{2+\cfrac{1}{2-\frac{1}{2}}}}$

(a) $\frac{-1}{2}$ (b) $-\frac{1}{8}$
(c) $-\frac{1}{6}$ (d) $-\frac{1}{4}$

**12.** The value of $\frac{2.75\times2.75\times2.75-2.25\times2.25\times2.25}{2.75\times2.75+2.75\times2.25+2.25\times2.25}$ is:

(a) 0.30 (b) 0.50
(c) 3.00 (d) 5.00

**13.** $\frac{\frac{1}{2}\div4+20}{\frac{1}{2}\times4+20}$ = ?

(a) $\frac{81}{88}$ (b) $2\frac{3}{11}$
(c) $\frac{161}{176}$ (d) 1

**14.** Evaluate $\frac{0.53\times0.53-2\times0.53\times0.41+0.41\times0.41}{0.53\times0.41}$

(a) 0.16 (b) 0.8
(c) 0.12 (d) None of these

**15.** The value of $\frac{9^2\times18^4}{3^{16}}$ is:

(a) $\frac{2}{3}$ (b) $\frac{4}{9}$
(c) $\frac{16}{81}$ (d) $\frac{32}{243}$

**16.** The simplification of $1 + \dfrac{1}{2+\dfrac{1}{1-\dfrac{1}{3}}}$ yields the result:

(a) $\frac{2}{7}$ (b) $\frac{7}{9}$

(c) $\frac{9}{7}$ (d) $\frac{13}{7}$

**17.** 108 + ? of $\frac{1}{3}+\frac{2}{5}\times 3\frac{3}{4}=10\frac{1}{2}$

(a) 15 (b) 63

(c) 24 (d) 36

**18.** The value of

$1 + 1+\frac{1}{4\times 3}+\frac{1}{4\times 3^2}+\frac{1}{4\times 3^3}$ up to four places of decimals is:

(a) 1.1202 (b) 1.1203

(c) 1.1204 (d) None of these

**19.** $\frac{3}{48}$ is what part of $\frac{1}{12}$?

(a) $\frac{3}{7}$ (b) $\frac{1}{12}$

(c) $\frac{3}{4}$ (d) None of these

**20.** The simplification of

$1+\dfrac{1}{1+\dfrac{1}{1-\dfrac{2}{3}}}$ yields the result

(a) $\frac{7}{4}$ (b) $\frac{4}{5}$

(c) $\frac{5}{4}$ (d) None of these

**21.** Which of the following fractions is less than $\frac{7}{8}$ and greater than $\frac{1}{3}$?

(a) $\frac{1}{4}$ (b) $\frac{23}{24}$

(c) $\frac{11}{12}$ (d) $\frac{17}{24}$

**22.** How many $\frac{1}{8}$'s are there in $37\frac{1}{2}$?

(a) 300 (b) 400

(c) 500 (d) Cannot be determined.

**23.** In a college, $\frac{1}{5}$th of the girls and $\frac{1}{8}$th of the boys took part in a social camp. What part of the total number of students in the college took part in the camp?

(a) $\frac{13}{40}$ (b) $\frac{13}{80}$

(c) $\frac{2}{13}$ (d) Data inadequate

**24.** $\left\{7\frac{1}{2}+\frac{1}{2}\div\frac{1}{2} \text{ of } \frac{1}{4}-\frac{2}{5}\times 2\frac{1}{3}\div 1\frac{7}{8} \text{ of } \left(1\frac{2}{5}-1\frac{1}{3}\right)\right\}$ =?

(a) $3\frac{1}{5}$ (b) $2\frac{1}{24}$

(c) $4\frac{1}{30}$ (d) None of these

**25.** When simplified, the product

$\left(2-\frac{1}{3}\right)\left(2-\frac{3}{5}\right)\left(2-\frac{5}{7}\right) \cdots \left(2-\frac{999}{1001}\right)$ is equal to:

(a) $\frac{991}{1001}$ (b) $\frac{1001}{13}$

(c) $\frac{1003}{3}$ (d) None of these

**26.** The value of $\frac{1}{1.2.3}+\frac{1}{2.3.4}+\frac{1}{3.4.5}+\frac{1}{4.5.6}$ is:

(a) $\frac{7}{30}$ (b) $\frac{1}{3}$

(c) $\frac{13}{30}$ (d) None of these

**27.** $15\,15\frac{2}{3}\times 3\frac{1}{6}+6\frac{1}{3}=11\frac{7}{18}$ + ?

(a) $39\frac{5}{9}$ (b) $137\frac{4}{9}$

(c) $29\frac{7}{9}$ (d) None of these

**28.** $3 \div \left[(8-5)\div\left\{(4-2)\div\left(2+\frac{8}{13}\right)\right\}\right]$ = ?

(a) $\frac{13}{17}$ (b) $\frac{68}{13}$

(c) $\frac{17}{13}$ (d) $\frac{13}{68}$

**29.** If the numbers $\frac{3}{5}, \frac{2}{3}, \frac{3}{4}$ are given, then we can say that:

(a) $\frac{3}{4} > \frac{3}{5} > \frac{2}{3}$ (b) $\frac{2}{3} > \frac{3}{5} > \frac{3}{4}$

(c) $\frac{3}{4} > \frac{2}{3} > \frac{3}{5}$ (d) $\frac{3}{5} > \frac{2}{3} > \frac{3}{4}$

**30.** $\frac{(272-32)(124+176)}{17\times15-15} = ?$

(a) 0 (b) 2.25
(c) 300 (d) None of these

**31.** If $\frac{a}{b} = \frac{1}{2}$, then $\frac{3a+2b}{3a-2b}$ is equal to:

(a) 3 (b) –3
(c) –5 (d) –1

**32.** $(20 \div 5) \div 2 + (16 \div 8) \times 2 + (10 \div 5) \times (3 \div 2) = ?$

(a) 9 (b) 12
(c) 15 (d) 18

**33.** $\frac{5}{6} \div \frac{6}{7} \times ? - \frac{8}{9} \div 1\frac{3}{5} + \frac{3}{4} \times 3\frac{1}{3} = 2\frac{7}{9}$

(a) $\frac{7}{6}$ (b) $\frac{6}{7}$

(c) 1 (d) None of these

**34.** $4\frac{1}{2} + 3\frac{1}{6} + ? + 2\frac{1}{3} = 13\frac{2}{3}$

(a) $3\frac{2}{5}$ (b) $1\frac{2}{5}$

(c) $4\frac{1}{5}$ (d) $4\frac{1}{6}$

**35.** The simplification of

$\frac{0.67\times0.67\times0.67-0.001}{0.67\times0.67+0.067+0.01}$ gives:

(a) 0.57 (b) 0.66
(c) 0.68 (d) 0.77

**36.** In a certain college, the number of girls is twice the number of boys. $\frac{1}{5}$th of the girls and $\frac{1}{8}$th of the boys took part in a social camp. What part of the total number of students took part in the camp?

(a) $\frac{7}{40}$ (b) $\frac{7}{80}$

(c) $\frac{2}{12}$ (d) $\frac{1}{24}$

**37.** If we multiply a fraction by itself and divide the product by its reciprocal, the fraction thus obtained is $18\frac{26}{27}$. The fraction is:

(a) $\frac{8}{27}$ (b) $2\frac{2}{3}$

(c) $1\frac{1}{3}$ (d) None of these

**38.** Which of the following numbers is the greatest?

(a) $(0.3)^2$ (b) $1 \div 0.3$

(c) $\frac{1}{8}$ (d) $\sqrt{0.49}$

**39.** What fraction must be subtracted from the sum of $\frac{1}{4}$ and $\frac{1}{6}$ to have an average of $\frac{1}{12}$ of all the three fractions?

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$

(c) $\frac{1}{4}$ (d) $\frac{1}{6}$

**40.** A person was to multiply a fraction by $\frac{6}{7}$. Instead, he divided and got an answer which exceeds the correct answer by $\frac{1}{7}$. The correct answer is:

(a) $\frac{6}{13}$ (b) $\frac{36}{91}$

(c) $\frac{7}{13}$ (d) None of these

**41.** $2 + \sqrt{2} + \frac{1}{2+\sqrt{2}} + \frac{1}{\sqrt{2}-2} = ?$

(a) 2 (b) 4
(c) 0 (d) Cannot be determined

**42.** The value of $\frac{1}{2} + \frac{1}{2.3} + \frac{1}{2.3.4} + \frac{1}{2.3.4.5}$ is correct to three places of decimal:

(a) 0.713 (b) 0.715
(c) 0.717 (d) 0.718

**43.** $\frac{?\div12}{0.2\times3.6} = 2$

(a) 17.82 (b) 17.22
(c) 17.28 (d) 17.12

**44.** $\sqrt{?\times7} \times 18 = 84$

(a) 3.11 (b) 3.12
(c) 3.13 (d) 3.14

**45.** The difference between the sum of $1\frac{3}{4}$, $2\frac{1}{3}$, $3\frac{5}{12}$, $5\frac{1}{5}$ and $2\frac{1}{6}$ and the nearest whole number is:

(a) $\frac{2}{15}$ (b) $\frac{13}{15}$
(c) $\frac{11}{60}$ (d) None of these

**46.** $\left(2\frac{3}{x}\right)\times\left(y\frac{1}{2}\right)=\frac{3}{4}$, find the values of $x$ and $y$.

(a) (3, 19) (b) (3, 14)
(c) (14, 3) (d) (24, 6)

**47.** If we multiply a fraction by itself and divide the product by the square of its reciprocal, the fraction obtained is $3\frac{13}{81}$. The original fraction is:

(a) $\frac{16}{9}$ (b) $\frac{8}{9}$
(c) $\frac{4}{3}$ (d) $\frac{1}{3}$

**48.** If $x \times y = (x + 2)^2(y - 2)$, then $7 \times 5 = ?$

(a) 234 (b) 243
(c) 343 (d) 423

**49.** If $m$ and $n$ are whole numbers such that $m^n = 121$, then $(m - 1)^{n+1} = ?$

(a) 10 (b) $10^2$
(c) $10^3$ (d) $10^4$

**50.** Between two fractions $\frac{1}{2}$ and $\frac{1}{8}$, how many fractions are there in all?

(a) Four (b) Zero
(c) Sixteen (d) Infinite

**51.** A boy was asked to multiply a given number by 8/17. Instead, he divided it by $\frac{8}{17}$ and got the result 225 more than what he should have got if he had multiplied the number by 8/17. The given number was:

(a) 8 (b) 17
(c) 64 (d) 136

**52.** The value of $\frac{1}{1.2}+\frac{1}{2.3}+\frac{1}{3.4}+...+\frac{1}{9.10}$ is:

(a) $\frac{11}{10}$ (b) $\frac{8}{9}$
(c) $\frac{9}{10}$ (d) $\frac{25}{1089}$

**53.** $\frac{\sqrt{1296}}{?}=\frac{?}{2.25}$

(a) 6 (b) 3
(c) 9 (d) 12

**54.** If we multiply a fraction by itself and divide the product by its reciprocal, the fraction thus obtained is $18\frac{26}{27}$. The original fraction is:

(a) $\frac{8}{27}$ (b) $2\frac{2}{3}$
(c) $1\frac{1}{3}$ (d) None of these

**55.** If $\frac{a}{a+b}=\frac{17}{23}$, what is $\frac{a+b}{a-b}$ equal to?

(a) $\frac{11}{23}$ (b) $\frac{17}{32}$
(c) $\frac{23}{11}$ (d) $\frac{23}{17}$

**56.** A tin of oil was $\frac{4}{5}$ the full when 6 bottles of oil were taken out. Again, 4 bottles of oil were poured into it, it was $\frac{3}{4}$ full. How many bottles of oil it may contain?

(a) 10 (b) 20
(c) 30 (d) 40

**57.** In an examination, a student was asked to find $\frac{3}{14}$ of a certain number. By mistake, he found $\frac{3}{4}$ of it. His answer was 150 more than the correct answer. The given number is:

(a) 180 (b) 240
(c) 280 (d) 290

**58.** The value of $\left(2-\frac{1}{3}\right)\left(2-\frac{3}{5}\right)\left(2-\frac{5}{7}\right)...\left(2-\frac{999}{1001}\right)$ is:

(a) $\frac{1003}{3}$ (b) $\frac{1003}{1001}$
(c) $\frac{1}{1001}$ (d) None of these

**59.** If $\sqrt{2^n} = 64$, then find the value of $n$.

(a) 8 (b) 10
(c) 12 (d) 16

**60.** If $10^{2y} = 25$, then what is the value of $10^y$?

(a) $-5$ (b) 5

(c) $\frac{1}{25}$ (d) $\sqrt{\frac{1}{25}}$

(e) None of these

**61.** $11\frac{1}{3} \times 4\frac{8}{10} \div ? = 22\frac{2}{3}$

(a) 2.4 (b) 4.2

(c) 2.6 (d) 2.8

**62.** Simplify:

$$\frac{a^{1/2} + a^{-1/2}}{1-a} + \frac{1-a^{-1/2}}{1+\sqrt{a}}$$

(a) $\frac{a}{a-1}$ (b) $\frac{a-1}{2}$

(c) $\frac{2}{a-1}$ (d) $\frac{2}{1-a}$

**63.** If $a^2 + b^2 = 45$ and $ab = 18$, find $\frac{1}{a} + \frac{1}{b}$.

(a) $\frac{1}{3}$ (b) $\frac{2}{3}$

(c) $\frac{1}{2}$ (d) Cannot be determined

**64.** If $\frac{a^2 + b^2}{c^2 + d^2} = \frac{ab}{cd}$, then find the value of $\frac{a+b}{a-b}$ in terms of $c$ and $d$ only.

(a) $\frac{c+d}{cd}$ (b) $\frac{cd}{c+d}$

(c) $\frac{c-d}{c+d}$ (d) $\frac{c+d}{c-d}$

**65.** $(1.06 + 0.04)^2 - ? = 4 \times 1.06 \times 0.04$

(a) 1.04 (b) 1.4

(c) 1.5 (d) Cannot be determined

**66.** The highest score in an inning was $\frac{2}{9}$ of the total score and the next highest was $\frac{2}{9}$ of the remainder. These scores differ by 8 runs. What was the total score in the innings?

(a) 162 (b) 152

(c) 142 (d) 132

**67.** Simplify $\left(\frac{1}{64}\right)^0 + (64)^{-1/2} + (-32)^{4/5}$

(a) $17\frac{1}{8}$ (b) $17\frac{3}{8}$

(c) $11\frac{7}{8}$ (d) $17\frac{7}{8}$

**68.** $\dfrac{\frac{64}{121} - \frac{9}{64}}{\frac{8}{11} + \frac{3}{8}} = ?$

(a) $\frac{88}{31}$ (b) $\frac{31}{88}$

(c) $\frac{41}{99}$ (d) $\frac{99}{41}$

**69.** When $\frac{1}{4}$ of a number is subtracted from $\frac{1}{3}$ of the same number, the remainder obtained is 12. The number is:

(a) 144 (b) 72

(c) 120 (d) 63

(e) None of these

**70.** What is the difference between the largest and the smallest fractions:

$\frac{5}{8}, \frac{21}{35}, \frac{9}{16}$ and $\frac{6}{7}$?

(a) $\frac{33}{112}$ (b) $\frac{11}{37}$

(c) $\frac{13}{41}$ (d) $\frac{9}{35}$

(e) None of these

**71.** If a man spends $\frac{5}{6}$ part of money and, again earns $\frac{1}{2}$ part of the remaining money, what part of his money is with him now?

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$

(c) $\frac{2}{3}$ (d) $\frac{3}{4}$

(e) $\frac{1}{3}$

**72.** Manmohan spends $\frac{1}{5}$ part of his money as pocket money and $\frac{4}{5}$ of the remainder in other affairs. If he is left with ₹48 per month, what is his monthly income?

(a) ₹360 (b) ₹400
(c) ₹320 (d) ₹300
(e) None of these

**73.** If the difference between $\frac{4}{5}$ part and $\frac{3}{4}$ part of a number is 4, what is the number?

(a) 60 (b) 100
(c) 80 (d) 40
(e) None of these

**74.** If $\frac{2}{3}$ part of a number is 96, what is the value of $\frac{3}{4}$ part of the same number?

(a) 48 (b) 192
(c) 108 (d) 72
(e) None of these

**75.** A man completes $\frac{2}{15}$ of his journey by aeroplane, $\frac{2}{5}$ by train and the rest by taxi. What part of his journey does he complete by taxi?

(a) $\frac{8}{15}$ (b) $\frac{7}{15}$
(c) $\frac{9}{15}$ (d) None of these

**76.** If $\left(1-\frac{1}{2}\right)\left(1-\frac{1}{3}\right)\left(1-\frac{1}{4}\right)\ldots\left(1-\frac{1}{70}\right)=\frac{x}{70}$, then what is the value of $x$?

(a) 69 (b) 35
(c) 20 (d) 15
(e) 1

**77.** The value of

$$\frac{1.073\times1.073-0.927}{1.073-0.927}+\frac{(3^4)^4\times9^6}{(27)^7\times(3)^9} \text{ is:}$$

(a) 2 (b) $\frac{1}{9}$
(c) $2\frac{1}{9}$ (d) $3\frac{1}{9}$
(e) None of these.

**78.** The value of

$$\frac{2^{1/2}\cdot3^{1/3}\cdot4^{1/4}}{10^{-1/5}\cdot5^{3/5}}\div\frac{3^{4/3}\cdot5^{-7/5}}{4^{-3/5}\cdot6} \text{ is:}$$

(a) 5 (b) 6
(c) 10 (d) 15
(e) None of these

## Exercise 2
## (Based on Memory)

**1.** If the numerator of a fraction is increased by 200% and the denominator of the fraction is increased by 150%, the resultant fraction is $\frac{7}{10}$. What is the original fraction?

(a) $\frac{3}{4}$ (b) $\frac{7}{12}$
(c) $\frac{7}{11}$ (d) $\frac{9}{11}$
(e) None of these

**[Bank of Maharashtra PO, 2008]**

**2.** What will come in place of questions mark (?) in the following equation?

$16^{7.5}\div8^{3.5}\div2^{7.5}=?$

(a) $8^4$ (b) $16^4$
(c) $2^{15}$ (d) $2^{27}$
(e) None of the above

**[SBI PO, 2005]**

**3.** $(a)^c\times(b)^a\times?=0$

(a) 1 (b) −1
(c) 0 (d) $(c)^b$
(e) None of these

**[SBI PO, 2005]**

**4.** $\left[\sqrt[3]{250047}+(56)^2\right]\div7=?$

(a) 547 (b) 475
(c) 455 (d) 521
(e) None of these

**[Andhra Bank PO, 2006]**

**5.** $\left[(\sqrt{529}\times 36)\div 48\right]\times ? = 5847.75$

(a) 346 (b) 317
(c) 339 (d) 325
(e) None of these

**[Andhra Bank PO, 2006]**

**6.** (16% of 480) + (?% of 978) = 653.82

(a) 48 (b) 57
(c) 61 (d) 63
(e) None of these

**[Andhra Bank PO, 2006]**

**7.** (0.56% of 225) × (3.25% of 430) = ?

(a) 17.6085 (b) 15.3195
(c) 15.6175 (d) 15.6175
(e) None of these

**[Andhra Bank PO, 2006]**

**8.** The difference between $\frac{3}{5}$ of $\frac{2}{3}$ of a number and $\frac{2}{5}$ of $\frac{1}{4}$ of the same number is 288. What is the number?

(a) 960 (b) 850
(c) 895 (d) 955
(e) None of these

**[Andhra Bank PO, 2006]**

**9.** By how much is $\frac{3}{4}$ of 52 lessser than $\frac{2}{3}$ of 99?

(*a*) 27 (b) 33
(c) 39 (d) 66
(e) None of these

**[IDBI Bank Officers, 2007]**

**10.** If the numerator of a fraction is increased by 400% and the denominator is increased by 500%. The resultant fraction is $\frac{15}{22}$. What was the original fractions?

(a) $\frac{9}{11}$ (b) $\frac{5}{11}$

(c) $\frac{7}{11}$ (d) $\frac{11}{13}$

(e) None of these

**[Corporation Bank PO, 2007]**

**11.** Which number should replace both the questions marks in the following equation?

$$\frac{?}{928}=\frac{58}{?}$$

(a) 212 (b) 227
(c) 232 (d) 247
(e) None of these

**[Andhra Bank PO, 2007]**

**12.** $3^{3.5}\times 21^{2}\times 42^{2.5}\div 2^{2.5}\times 7^{3.5} = 21^{?}$

(a) 8 (b) 10
(c) 12.5 (d) 6.5
(e) None of these

**[Corporation Bank PO, 2006]**

**13.** If $x=\frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}-\sqrt{3}}$ and $y=\frac{\sqrt{5}-\sqrt{3}}{\sqrt{5}+\sqrt{3}}$, then $(x+y)$ equals:

(a) 8 (b) 16

(c) $2\sqrt{15}$ (d) $2\left(\sqrt{5}+\sqrt{3}\right)$

**[SSC (GL) Prel. Examination, 2005]**

**14.** $\left[\frac{1}{\sqrt{2}+\sqrt{3}-\sqrt{5}}+\frac{1}{\sqrt{2}-\sqrt{3}-\sqrt{5}}\right]$ in simplified form equals:

(a) 1 (b) $\sqrt{2}$

(c) $\frac{1}{\sqrt{2}}$ (d) 0

**[SSC (GL) Prel. Examination, 2005]**

**15.** If * represents a number, then the value of * in $5\frac{3}{*}\times 3\frac{1}{2}=19$ is:

(a) 7 (b) 4
(c) 6 (d) 2

**[SSC (GL) Prel. Examination, 2005]**

**16.** $\left(1-\frac{1}{2}\right)\left(1-\frac{1}{3}\right)\left(1-\frac{1}{4}\right)...\left(1-\frac{1}{100}\right)$ results in:

(a) 0.01 (b) 0.001
(c) 1 (d) 0.1

**[SSC (GL) Prel. Examination, 2005]**

**17.** $\left(\frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}-\sqrt{3}}\right)^{2}+\left(\frac{\sqrt{5}-\sqrt{3}}{\sqrt{5}+\sqrt{3}}\right)^{2}$ is equal to:

(a) 64 (b) 62
(c) 66 (d) 68

**[SSC (GL) Prel. Examination, 2000]**

**18.** If $25^{25}$ is divisible by 26, the remainder is:

(a) 1 (b) 2
(c) 24 (d) 25

**[SSC (GL) Prcl. Examination, 2000]**

**19.** $\sqrt{6+\sqrt{6+\sqrt{6+...}}}$

(a) $6^{2/3}$ (b) 6
(c) $3^{1/3}$ (d) 3

**[SSC (GL) Prel. Examination, 2000]**

**20.** First 100 multiples of 10 are multiplied together. The number of zeros at the end of the product must be:

(a) 125 (b) 120
(c) 111 (d) 110

**[SSC (GL) Prel. Examination, 2000]**

**21.** $(16)^{0.16} \times (16)^{0.04} \times (2)^{0.2}$ is equal to:

(a) 1 (b) 2
(c) 4 (d) 16

**[SSC (GL) Prel. Examination, 2000]**

**22.** A number divided by 68 gives the quotient 269 and remainder zero. If the same number is divided by 67, the remainder is:

(a) 0 (b) 1
(c) 2 (d) 3

**[SSC (GL) Prel. Examination, 2000]**

**23.** The product of two fractions is $\frac{14}{15}$ and their quotient is $\frac{35}{24}$. The greater fraction is:

(a) $\frac{7}{4}$ (b) $\frac{7}{6}$

(c) $\frac{7}{3}$ (d) $\frac{4}{5}$

**[SSC (GL) Prel. Examination, 2002]**

**24.** Which of the following numbers is least?

$(0.5)^2$, $\sqrt{0.49}$, $\sqrt[3]{0.008}$, 0.23

(a) $(0.5)^2$ (b) $\sqrt{0.49}$

(c) $\sqrt[3]{0.008}$ (d) 0.23

**[SSC (GL) Prel. Examination, 2002]**

**25.** Find the value of * in the following:

$$1\frac{2}{3} \div \times \frac{*}{7} = 1\frac{1}{4} \times \frac{2}{3} \div \frac{1}{6}$$

(a) $\frac{1}{6}$ (b) 0.6

(c) 0.006 (d) 6

**[SSC (GL) Prel. Examination, 2002]**

**26.** A certain amount of money is distributed among A, B and C. A gets $\frac{3}{16}$ and B gets $\frac{1}{4}$ of the whole amount. If C gets ₹81, then B gets:

(a) ₹30 (b) ₹36
(c) ₹32 (d) ₹40

**[SSC (GL) Prel. Examination, 2002]**

**27.** The greatest number which when divides 989 and 1327 leave remainders 5 and 7, respectively, is:

(a) 8 (b) 16
(c) 24 (d) 32

**[SSC (GL) Prel. Examination, 2002]**

**28.** If * means adding 6 times the second number to the first number then (1 * 2) * 3 equals:

(a) 121 (b) 31
(c) 93 (d) 91

**[SSC (GL) Prel. Examination, 2003]**

**29.** Find the value of $\dfrac{2}{1+\dfrac{1}{1-\dfrac{1}{2}}} \times \dfrac{3}{\dfrac{5}{6} \text{ of } \dfrac{3}{2} \div 1\dfrac{1}{4}}$

(a) 6 (b) 8
(c) 4 (d) 2

**[SSC (GL) Prel. Examination, 2003]**

**30.** If $x * y = x^2 + y^2 - xy$, the value of 9 * 11 is:

(a) 93 (b) 103
(c) 113 (d) 121

**[SSC (GL) Prel. Examination, 2003]**

**31.** A man spends $\frac{1}{3}$ of his income on food, $\frac{2}{5}$ of his income on house rent and $\frac{1}{5}$ of his income on clothes. If he still has ₹400 left with him, his income is:

(a) ₹4000 (b) ₹5000
(c) ₹6000 (d) ₹7000

**[SSC (GL) Prel. Examination, 2003]**

**32.** If $a * b = 2a + 3b$, then the value If 2 * 3 + 3 * 4 is:

(a) 24 (b) 31
(c) 32 (d) 34

**[SSC (GL) Prel. Examination, 2002]**

**33.** The simplified value of $\left[\sqrt[3]{\sqrt[6]{2^9}}\right]^4 \times \left[\sqrt[6]{\sqrt[3]{2^9}}\right]^4$ is:

(a) $2^{16}$ (b) $2^{12}$
(c) $2^8$ (d) $2^4$

**[SBI PO Examination, 2000]**

**34.** The value of the following is:

$$\sqrt{10+\sqrt[3]{25+\sqrt{108+\sqrt[3]{154+\sqrt{225}}}}}$$

(a) 10 (b) 8
(c) 6 (d) 4

**[Bank of Baroda PO, 1999]**

**35.** What will come in place of the question mark (?) in the following equation?

$25^{7.5} \times 5^{2.5} \div 125^{1.5} = 5$ ?

(a) 16 (b) 17.5
(c) 8.5 (d) 13
(e) None of these

**[PNB Management Trainee Examination, 2003]**

**36.** Two-fifths of one-third for three-sevenths of a number is 15. What is 40 per cent of that number?

(a) 136 (b) 140
(c) 72 (d) 84
(e) None of these

**[IBPS Jr. Executive Examination, 2002]**

**37.** By how much is two-fifths of 200 greater than three-fifths of 125?

(a) 15 (b) 3
(c) 5 (d) 30
(e) None of these

**[Canara Bank PO, 2003]**

**38.** Which of the following has fractions in ascending order?

(a) $\frac{2}{3}, \frac{3}{5}, \frac{7}{9}, \frac{9}{11}, \frac{8}{9}$ (b) $\frac{3}{5}, \frac{2}{3}, \frac{7}{9}, \frac{9}{11}, \frac{8}{9}$

(c) $\frac{8}{9}, \frac{9}{11}, \frac{7}{9}, \frac{3}{5}, \frac{2}{3}$ (d) $\frac{3}{5}, \frac{2}{3}, \frac{9}{11}, \frac{7}{9}, \frac{8}{9}$

(e) $\frac{8}{9}, \frac{9}{11}, \frac{7}{9}, \frac{2}{3}, \frac{3}{5}$

**[NABARD Asst. Manager Examination, 2002]**

**39.** What should come in place of the question mark (?) in the following equation:

$47^{7.5} \div 47^{3/2} \times 47^{-3} = \left(\sqrt{47}\right)$

(a) 3 (b) $2\frac{1}{2}$
(c) 6 (d) 3.5
(e) None of these

**[BSRB Patana PO, 2001]**

**40.** What should come in the place of the question mark (?) in the following equation?

$$\frac{(7\times ?)^2}{49} = \sqrt{81}$$

(a) 9 (b) 2
(c) 4 (d) None of these

**[BSRB Delhi PO, 2000]**

**41.** $\frac{(10008.99)^2}{10009.001} \times \sqrt{3589} \times 0.4987 = ?$

(a) 3000 (b) 300000
(c) 3000000 (d) 5000
(e) 9000000

**[BSRB Bhopal PO, 2000]**

**42.** In a set of 5 numbers the sum of two of these numbers is 6 more than the sum of the remaining three numbers, whereas the sum of these two numbers is two times one of those numbers. What definitely is one of those two numbers?

(a) 18 (b) 12
(c) 16 (d) Data inadequate
(e) None of these

**[BSRB Chennai PO, 2000]**

**43.** Multiply the difference between the two lowest numbers with the difference between the two highest numbers in the following sequences:

89 7 91 72 31 25 18 89 16 58 38 42 86

(a) 18 (b) 77
(c) 81 (d) 16
(e) None of these

**[NABARD, 1999]**

**44.** $\frac{1}{5}$ of a number is equal to $\frac{5}{8}$ of the second number. If 35 is added to the first number it becomes 4 times of second number. What is the value of the second number?

(a) 125 (b) 70
(c) 40 (d) 25
(e) None of these

**[NABARD, 1999]**

**45.** At the first stop on his route, a driver unloaded two-fifths of the packages in his van. After he unloaded another three packages at his next stop, half of the original number of packages in the van remained. How many packages were in the van before the first delivery?

(a) 10 (b) 25
(c) 30 (d) 36

**46.** Which of the given numbers is the greatest?

(a) $6\sqrt{5}$ (b) $8\sqrt[3]{2}$
(c) $2\sqrt[3]{130}$ (d) $\sqrt[3]{900}$

**47.** If $x = 2 + 2^{2/3} + 2^{1/3}$, then the value of $x^3 - 6x^2 + 6x$ is:

(a) 3 (b) 2
(c) 1 (d) None of these.

**48.** $\sqrt[3]{\dfrac{72.9}{0.4096}}$ is equal to:

(a) 0.5625 (b) 5.625
(c) 182 (d) 13.6

**[SSC (GL) Prel. Examination, 2000]**

**49.** If the square root of 5 is 2.236, then the square root of 80 equals = 2.236 times of:

(a) 2 (b) 2.5
(c) 4 (d) 5

**[SSC (GL) Prel. Examination, 2000]**

**50.** The digit in the unit's place in the cube root of 21952 is:

(a) 8 (b) 6
(c) 4 (d) 2

**[SSC (GL) Prel. Examination, 2000]**

**51.** Given, $\sqrt{5} = 2.2361$, $\sqrt{3} = 1.7321$, then $\dfrac{1}{\sqrt{5}-\sqrt{3}}$ is equal to:

(a) 1.984 (b) 1.9841
(c) 1.98 (d) 2

**[SSC (GL) Prel. Examination, 2000]**

**52.** The square root of $(272^2 - 128^2)$ is:

(a) 256 (b) 200
(c) 240 (d) 144

**[SSC (GL) Prel. Examination, 2000]**

**53.** The square root of 0.9 is equal to:

(a) 0.3 (b) 0.03
(c) 0.94 (d) 0.81

**[SSC (GL) Prel. Examination, 2000]**

**54.** The square root of $\dfrac{0.342 \times 0.684}{0.000342 \times 0.000171}$ is:

(a) 250 (b) 2500
(c) 2000 (d) 4000

**[SSC (GL) Prel. Examination, 2002]**

**55.** If cube root of 175616 is 56, then the value of $\sqrt[3]{175.616} + \sqrt[3]{0.175616} + \sqrt[3]{0.000175616}$ is equal to:

(a) 0.168 (b) 62.16
(c) 6.216 (d) 6.116

**[SSC (GL) Prel. Examination, 2002]**

**56.** Given $\sqrt{2} = 1.414$, then the value of $\sqrt{8} + \sqrt[2]{32} - \sqrt[3]{128} + \sqrt[4]{50}$ is:

(a) 8.484 (b) 8.526
(c) 8.426 (d) 8.876

**[SSC (GL) Prel. Examination, 2003]**

**57.** $\sqrt{\sqrt[3]{0.004096}}$ is equal to:

(a) 4 (b) 0.4
(c) 0.04 (d) 0.004

**[SSC (GL) Prel. Examination, 2003]**

**58.** If $\sqrt{15} = 3.88$, then what is the value of $\sqrt{\dfrac{5}{3}}$.

(a) $1.29\overline{3}$ (b) 1.2934
(c) 1.29 (d) 1.295

**[SSC (GL) Prel. Examination, 2003]**

**59.** If the square root of 5625 is 75, then $\sqrt{5625} + \sqrt{56.25} + \sqrt{0.5625} =$

(a) 9 (b) 83.25
(c) 82.80 (d) 8.325

**[SSC (GL) Prel. Examination, 2002]**

**60.** What approximate value should come in place of the question mark (?)?

$36.0001 \div 5.9998 \times \sqrt{?} = 108.0005$

(a) 18 (b) 16
(c) 256 (d) 325

**[Bank of Maharashtra PO Examination, 2003]**

**61.** $\sqrt{10000} + \dfrac{3.001}{4.987}$ of 1891.992 = ?

(a) 2500 (b) 1230
(c) 1640 (d) 1525

**[Canara Bank PO Examination, 2003]**

**62.** $1.\overline{27}$ in the form $\frac{p}{q}$ is equal to:

(a) $\frac{127}{100}$ (b) $\frac{73}{100}$

(c) $\frac{14}{11}$ (d) $\frac{11}{14}$

**[SSC (GL) Examination, 2010]**

**63.** It $2p + \frac{1}{p} = 4$ the value of $p^3 + \frac{1}{8p^3}$ is:

(a) 4 (b) 5

(c) 8 (d) 15

**[SSC (GL) Examination, 2010]**

**64.** $(0.1 \times 0.01 \times 0.001 \times 10^7)$ is equal to:

(a) 100 (b) $\frac{1}{10}$

(c) $\frac{1}{100}$ (d) 10

**[SSC (GL) Examination, 2010]**

**65.** Simplified form of $\left[\left(\sqrt[5]{x^{-3/5}}\right)^{-5/3}\right]^5$ is:

(a) $x^5$ (b) $x^{-5}$

(c) $x$ (d) $\frac{1}{x}$

**[SSC (GL) Examination, 2010]**

**66.** $\left(1-\frac{1}{3}\right)\left(1-\frac{1}{4}\right)\left(1-\frac{1}{5}\right)...\left(1-\frac{1}{25}\right)$ is equal to:

(a) $\frac{2}{25}$ (b) $\frac{1}{25}$

(c) $1\frac{19}{25}$ (d) $\frac{1}{325}$

**[SSC (GL) Examination, 2010]**

**67.** The value of $\frac{3\sqrt{2}}{\sqrt{3}+\sqrt{6}} - \frac{4\sqrt{3}}{\sqrt{6}+\sqrt{2}} + \frac{\sqrt{6}}{\sqrt{3}+\sqrt{2}}$ is:

(a) 4 (b) 0

(c) 12 (d) $3\sqrt{6}$

**[SSC (GL) Examination, 2011]**

**68.** The value of $\dfrac{2\frac{1}{3} - 1\frac{2}{11}}{3 + \cfrac{1}{3 + \cfrac{1}{3 + \cfrac{1}{3}}}}$ is:

(a) $\frac{38}{109}$ (b) $\frac{109}{38}$

(c) 1 (d) $\frac{116}{109}$

**[SSC (GL) Examination, 2011]**

**69.** The value of $3 + \frac{1}{\sqrt{3}} + \frac{1}{3+\sqrt{3}} + \frac{1}{\sqrt{3}-3}$ is:

(a) $3 + \sqrt{3}$ (b) 3

(c) 1 (d) 0

**[SSC (GL) Examination, 2011]**

**70.** If $x + \cfrac{2}{3 + \cfrac{4}{5 + \cfrac{7}{6}}} = 10$ then the value of $x$ is:

(a) $\frac{1276}{135}$ (b) $\frac{53}{6}$

(c) 4.35 (d) 9

**[SSC (GL) Examination, 2011]**

**71.** The value of $3 + \cfrac{3}{3 + \cfrac{1}{3 + \cfrac{1}{3}}}$

(a) $\frac{40}{11}$ (b) $\frac{43}{11}$

(c) $\frac{46}{11}$ (d) $\frac{41}{11}$

**[SSC (GL) Examination, 2011]**

**72.** If $x = \sqrt{\frac{\sqrt{5}+1}{\sqrt{5}-1}}$, then, the value of $5x^2 - 5x - 1$ is:

(a) 0 (b) 3

(c) 4 (d) 5

**[SSC (GL) Examination, 2011]**

**73.** If $\frac{\sqrt{3+x}+\sqrt{3-x}}{\sqrt{3+x}-\sqrt{3-x}} = 2$, then $x$ is equal to:

(a) $\frac{5}{12}$ (b) $\frac{12}{5}$

(c) $\frac{5}{7}$ (d) $\frac{7}{5}$

**[SSC (GL) Examination, 2010]**

**74.** The number 0.121212 ... in the form $\frac{p}{q}$ is equal to:

(a) $\frac{4}{11}$ (b) $\frac{2}{11}$

(c) $\frac{4}{33}$ (d) $\frac{2}{33}$

**[SSC (GL) Examination, 2010]**

**75.** $3\frac{3}{4}+4\frac{2}{5}-3\frac{1}{8} = ?$

(a) $4\frac{1}{40}$ (b) $5\frac{1}{40}$

(c) $6\frac{1}{40}$ (d) $5\frac{3}{40}$

**[Bank of Baroda PO Examination, 2010]**

**76.** $\sqrt{5^2 \times 14 - 6 \times 7 + (4)^?} = 18$

(a) 1 (b) 3
(c) 4 (d) None of these.

**[Bank of Baroda PO Examination, 2010]**

**77.** 67.99% of 1401 − 13.99% of 1299 = ?

(a) 700 (b) 720
(c) 770 (d) 800

**[Bank of Baroda PO Examination, 2011]**

**78.** $\left(\frac{24}{9}\right)^2 \times \frac{399}{39} \div \frac{41}{899} = ?$

(a) 1600 (b) 1650
(c) 1700 (d) 1550

**[Bank of Baroda PO Examination, 2011]**

**79.** $(15 \times 0.40)^4 \div (1080 \div 30)^4 \times (27 \times 8)^4 = (3 \times 2)^{?+5}$

(a) 8 (b) 3
(c) 12 (d) 16

**[Bank of Baroda PO Examination, 2011]**

**80.** $3\frac{1}{4}+2\frac{1}{2}-1\frac{5}{6} = \frac{(?)^2}{10}+1\frac{5}{12}$

(a) 25 (b) $\sqrt{5}$

(c) 625 (d) 5

**[Bank of Baroda PO Examination, 2011]**

**81.** $92 \times 576 \div 2\sqrt{1296} = (?)^3 + \sqrt{49}$

(a) 3 (b) $(9)^2$
(c) 9 (d) 27

**[Bank of Baroda PO Examination, 2011]**

**82.** $\frac{1}{6}$ of (92)% of $1\frac{1}{23}$ of (650) = 85 + ?

(a) 18 (b) 21
(c) 19 (d) 28

**[Bank of Baroda PO Examination, 2011]**

**83.** Seema bought 20 pens, 8 packets of wax colours, 6 calculators, and 7 pencil boxes. The price of a pen is ₹7, a packet of wax colour is ₹22, a calculator is ₹175, and a pencil box is ₹14 more than the combined price of one pen and one packet of wax colours. How much amount did Seema pay to the shopkeeper?

(a) ₹1491 (b) ₹1725
(c) ₹1667 (d) ₹1527

**[IBPS Bank PO Examination, 2011]**

**84.** If $a^2+b^2+c^2 = ab+bc+ac$, then the value of $\frac{a+c}{b}$ is:

(a) 0 (b) 2
(c) 1 (d) −1

**[SSC Examination, 2014]**

**85.** If $ab+bc+ca=0$, then the value of $\left(\frac{1}{a^2-bc}+\frac{1}{b^2-ca}+\frac{1}{c^2-ab}\right)$ is:

(a) 0 (b) 1
(c) 3 (d) $a+b+c$

**[SSC Examination, 2014]**

**86.** If $\left(2+\sqrt{3}\right)a = \left(2-\sqrt{3}\right)b = 1$, then the value of $\frac{1}{a}+\frac{1}{b}$ is:

(a) 1 (b) 2
(c) $2\sqrt{3}$ (d) 4

**[SSC Examination, 2014]**

**87.** If $3x+\frac{3}{x}=1$, then $x^3+\frac{1}{x^3}+1$ is:

(a) 0 (b) $\frac{1}{27}$

(c) $\frac{5}{27}$ (d) $\frac{28}{27}$

**[SSC Examination, 2014]**

**88.** The value of $\frac{1}{a^2+ax+x^2}-\frac{1}{a^2-ax+x^2}+\frac{2ax}{a^4+a^2x^2+x^4}$ is:

(a) 2 (b) 1
(c) −1 (d) 0

**[SSC Examination, 2014]**

**89.** If $x = y = 333$ and $z = 334$, then the values of $x^3 + y^3 + z^3 - 3xyz$ is:

(a) 0 (b) 667
(c) 1000 (d) 2334

**[SSC, 2013]**

**90.** If $\frac{x-a^2}{b+c}+\frac{x-b^2}{c+a}+\frac{x-c^2}{a+b}=4(a+b+c)$, then $x$ is equal to:

(a) $(a + b + c)^2$
(b) $a^2 + b^2 + c^2$
(c) $ab + bc + ca$
(d) $a^2 + b^2 + c^2 - ab - bc - ca$

**[SSC, 2013]**

**91.** If $(x - a)(x - b) = 1$ and $a - b + 5 = 0$, then the value of $(x-a)^3-\frac{1}{(x-a)^3}$ is:

(a) –125 (b) 1
(c) 125 (d) 140

**[SSC, 2013]**

**92.** The value of $\sqrt{2\sqrt[3]{4\sqrt{2\sqrt[3]{4\sqrt{2\sqrt[3]{4\ldots}}}}}}$ is:

(a) 2 (b) 22
(c) 23 (d) 25

**[SSC, 2013]**

**93.** The value of $\left\{\frac{3\sqrt{2}}{(\sqrt{3}+\sqrt{6})}-\frac{4\sqrt{3}}{(\sqrt{6}+\sqrt{2})}+\frac{\sqrt{6}}{(\sqrt{2}+\sqrt{3})}\right\}$ is:

(a) $\sqrt{2}$ (b) 0
(c) $\sqrt{3}$ (d) $\sqrt{6}$

**[SSC, 2013]**

**94.** If $a^2 + b^2 - c^2 = 2(a - b - c) - 3$, then the value of $4a - 3b + 5c$ is:

(a) 2 (b) 3
(c) 5 (d) 6

**[SSC, 2013]**

**95.** If $2x+\frac{2}{x}=3$, then the value of $x^3+\frac{1}{x^3}+2$ is:

(a) $-\frac{9}{8}$ (b) $-\frac{25}{8}$
(c) $\frac{7}{8}$ (d) 11

**[SSC, 2013]**

**96.** Out of the given responses, one of the factors of $(a^2 - b^2)^3 + (b^2 - c^2)^3 + (c^2 - a^2)^3$ is:

(a) $(a + b)(a - b)$ (b) $(a + b)(a + b)$
(c) $(a - b)(a - b)$ (d) $(b - c)(b - c)$

**[SSC, 2013]**

**97.** If $x=\sqrt[3]{5}+2$, then the value of $x^3 - 6x^2 + 12x - 13$ is:

(a) –1 (b) 1
(c) 2 (d) 0

**[SSC, 2013]**

**98.** The value of $(3+\sqrt{8})+\frac{1}{3-\sqrt{8}}-(6+4\sqrt{2})$ is:

(a) 8 (b) 1
(c) $\sqrt{2}$ (d) 0

**[SSC Assistant Grade III, 2013]**

**99.** If $x > 1$ and $x^2+\frac{1}{x^2}=83$, then $x^3-\frac{1}{x^3}$ is:

(a) 764 (b) 750
(c) 756 (d) 760

**[SSC Assistant Grade III, 2013]**

**100.** If $\left(a+\frac{1}{a}\right)^2=3$, then $a^3+\frac{1}{a^3}=?$

(a) $2\sqrt{3}$ (b) 2
(c) $3\sqrt{3}$ (d) 0

**[SSC Assistant Grade III, 2013]**

**101.** If $a=7-4\sqrt{3}$, the value of $a^{\frac{1}{2}}+a^{-\frac{1}{2}}$ is:

(a) $3\sqrt{3}$ (b) 4
(c) 7 (d) $2\sqrt{3}$

**[SSC Assistant Grade III, 2013]**

**102.** $\frac{3\sqrt{2}}{\sqrt{6}-\sqrt{3}}-\frac{4\sqrt{3}}{\sqrt{6}-\sqrt{2}}-\frac{6}{\sqrt{8}+\sqrt{12}}=?$

(a) 1 (b) $-\sqrt{3}$
(c) $\sqrt{3}+\sqrt{2}$ (d) $\sqrt{3}-\sqrt{2}$

**[SSC Assistant Grade III, 2012]**

**103.** If $x+y+z=1,\ xy+yz+zx=-1,\ xyz=-1,$ then $x^3+y^3+z^3$ is:

(a) –2 (b) –1
(c) 0 (d) 1

**[SSC Assistant Grade III, 2012]**

**104.** If $x^2+y^2+z^2=xy+yz+zx,\ (x\neq 0)$, then the value of $\frac{4x+2y-3z}{2x}$ is:

(a) 0 (b) 1
(c) $\frac{3}{2}$ (d) $\frac{1}{2}$

**[SSC Assistant Grade III, 2012]**

**105.** If $x\left(3-\frac{2}{x}\right)=\frac{3}{x}$, $x \neq 0$, then the value of $x^2+\frac{1}{x^2}$ is:

(a) $2\frac{1}{3}$ (b) $2\frac{2}{3}$

(c) $2\frac{4}{9}$ (d) $2\frac{5}{9}$

**[SSC Assistant Grade III, 2012]**

**106.** If $x^2+y^2+z^2+2=2(y-x)$, then value of $x^3+y^3+z^3$ is equal to:

(a) 0 (b) 1

(c) 2 (d) 3

**[SSC Assistant Grade III, 2012]**

**107.** If $a^3b = abc = 180$, and $a$, $b$, $c$ are positive integers, then the value of $c$ is:

(a) 110 (b) 1

(c) 4 (d) 25

**[SSC, 2012]**

**108.** If $\left(x+\frac{1}{x}\right)^2=3$, then the value of $(x^{72}+x^{66}+x^{54}+x^{36}+x^{24}+x^6+1)$ is:

(a) 1 (b) 2

(c) 3 (d) 4

**[SSC, 2012]**

**109.** If $a+b+c=0$, then the value of $\frac{a^2+b^2+c^2}{a^2-bc}$ is:

(a) 0 (b) 1

(c) 2 (d) 3

**[SSC, 2012]**

**110.** If $n=7+4\sqrt{3}$, then the value $\left(\sqrt{n}+\frac{1}{\sqrt{n}}\right)$ is:

(a) $2\sqrt{3}$ (b) 4

(c) $-4$ (d) $-2\sqrt{3}$

**[SSC, 2012]**

**111.** If $a+b+c=6$, $a^2+b^2+c^2=14$ and $a^3+b^3+c^3=36$, then the value of $abc$ is:

(a) 3 (b) 6

(c) 9 (d) 12

**[SSC, 2012]**

**112.** If $a$, $b$ are rational numbers and $(a-1)\sqrt{2}+3=b\sqrt{2}+a$, the value of $(a+b)$ is:

(a) $-5$ (b) 3

(c) $-3$ (d) 5

**[SSC, 2012]**

**113.** If $\left(x+\frac{1}{x}\right)^2=3$, then the value of $x^{206}+x^{200}+x^{90}+x^{84}+x^{18}+x^{12}+x^6+1$ is:

(a) 0 (b) 1

(c) 84 (d) 206

**[SSC, 2012]**

**114.** The value of $\frac{(81)^{3.6}\times(9)^{2.7}}{(81)^{4.2}\times(3)}$ is:

(a) 3 (b) 6

(c) 9 (d) 8.2

**[SSC, 2011]**

**115.** While selling, a businessman allows 40% discount on the marked price and there is a loss of 30%. If it is sold at the marked price, profit percent will be:

(a) 10% (b) 20%

(c) $16\frac{2}{3}\%$ (d) $16\frac{1}{3}\%$

**[SSC, 2011]**

**116.** If $a^2+b^2+c^2=2(a-b-c)-3$, then the value of $(a-b+c)$ is:

(a) $-1$ (b) 3

(c) 1 (d) $-2$

**[SSC, 2011]**

**117.** If $x^2+3x+1=0$, then the value of $x^3+\frac{1}{x^3}$ is:

(a) $-18$ (b) 18

(c) 36 (d) $-36$

**[SSC, 2011]**

**118.** If $x^a \cdot x^b x^c = 1$, then the value of $a^3+b^3+c^3$ is:

(a) 9 (b) $abc$

(c) $a+b+c$ (d) $3abc$

**[SSC, 2011]**

**119.** If $a+\frac{1}{a}+2=0$, then the value of $\left(a^{37}-\frac{1}{a^{100}}\right)$ is:

(a) 0 (b) $-2$

(c) 1 (d) 2

**[SSC, 2011]**

**120.** If $x+\frac{1}{16x}=1$, then the value of $64x^3+\frac{1}{64x^3}$ is:

(a) 4 (b) 52

(c) 64 (d) 76

**121.** If $a$, $b$, $c$ are three non-zero real numbers such that $a+b+c=0$; and $b^2 \neq ca$, then the value of $\frac{a^2+b^2+c^2}{b^2-ca}$ is:

(a) 3 (b) 2
(c) 0 (d) 1

**[SSC, 2011]**

**122.** If $a^4 + a^2b^2 + b^2 = 8$ and $a^2 + ab + b^2 = 4$, then the value of $ab$ is:

(a) −1 (b) 0
(c) 0 (d) 1

**[SSC, 2011]**

**123.** If $a = 25$, $b = 15$, $c = -10$; then the value of $\dfrac{a^3+b^3+c^3-3abc}{(a-b)^2+(b-c)^2+(c-a)^2}$ is:

(a) 30 (b) −15
(c) −30 (d) 15

**[SSC, 2011]**

**124.** If $x^{\frac{1}{3}} + y^{\frac{1}{3}} = z^{\frac{1}{3}}$, then $(x + y - z)^3 + 27\,xyz$ is equal to:

(a) 0 (b) 1
(c) −1 (d) 27

**[SSC, 2010]**

**125.** If $\sqrt{7\sqrt{7\sqrt{7\sqrt{7\sqrt{7\cdots}}}}} = (343)^{y-1}$, then $y$ is equal to:

(a) $\dfrac{2}{3}$ (b) 1
(c) $\dfrac{4}{3}$ (d) $\dfrac{3}{4}$

**[SSC, 2010]**

**126.** If $a + b + c = 1$ and $ab + be + ca = \dfrac{1}{3}$, then $a$:$b$:$c$ is:

(a) 1:2:2 (b) 2:1:2
(c) 1:1:1 (d) 1:2:1

**[SSC, 2010]**

**127.** If $a^2 + b^2 + \dfrac{1}{a^2} + \dfrac{1}{b^2} = 4$, then the value of $a^2 + b^2$ will be:

(a) 1 (b) $1\dfrac{1}{2}$
(c) 2 (d) $2\dfrac{1}{2}$

**[SSC, 2010]**

**128.** If $\left(x+\dfrac{1}{x}\right)^2 = 3$, then $\left(x^3+\dfrac{1}{x^3}\right)$ is equal to:

(a) 3 (b) 2
(c) 1 (d) 0

**[SSC, 2010]**

**129.** $\dfrac{0.1\times0.1\times0.1+0.02\times0.02\times0.02}{0.2\times0.2\times0.2+0.04\times0.04\times0.04}$ is equal to:

(a) 0.125 (b) 0.250
(c) 0.500 (d) 0.855

**[SSC, 2010]**

**130.** If $x+\dfrac{1}{x}=2$, then the value of $x^{100}+\dfrac{1}{x^{100}}$ is:

(a) 2 (b) 0
(c) 1 (d) −2

**[SSC, 2010]**

**131.** If $x^3 + 3x^2 + 3x = 7$, then $x$ is equal to:

(a) 2 (b) $\sqrt[3]{6}$
(c) 1 (d) −1

**[SSC, 2010]**

**132.** If $2x+\dfrac{2}{x}=1$, then the value of $x^3+\dfrac{1}{x^3}$ is:

(a) $\dfrac{13}{8}$ (b) $-\dfrac{11}{8}$
(c) $\dfrac{11}{8}$ (d) $-\dfrac{13}{8}$

**[SSC, 2010]**

**133.** $\dfrac{\sqrt{7}}{\sqrt{16+6\sqrt{7}}-\sqrt{16-6\sqrt{7}}}$ is equal to:

(a) $\dfrac{1}{2}$ (b) $\dfrac{1}{3}$
(c) $\dfrac{1}{4}$ (d) $\dfrac{1}{5}$

**[SSC, 2010]**

**134.** If $2x+\dfrac{1}{3x}=6$, then $3x+\dfrac{1}{2x}$ is equal to:

(a) 4 (b) 8
(c) 9 (d) 12

**[SSC, 2010]**

**135.** If $x=(\sqrt{2}-1)^{\frac{1}{2}}$, then the value of $\left(x^2-\dfrac{1}{x^2}\right)$ is:

(a) 2 (b) $-2\sqrt{2}$
(c) $2\sqrt{2}$ (d) $-\sqrt{2}$

**[SSC, 2010]**

**136.** $\dfrac{3}{4}\left(1+\dfrac{1}{3}\right)\left(1+\dfrac{2}{3}\right)\left(1-\dfrac{2}{5}\right)\left(1+\dfrac{6}{7}\right)\left(1-\dfrac{12}{13}\right)$ is equal to:

(a) $\dfrac{2}{13}$ (b) $\dfrac{1}{7}$
(c) $\dfrac{1}{6}$ (d) $\dfrac{1}{5}$

**[SSC, 2010]**

**137.** $\dfrac{(0.87)^3+(0.13)^3}{(0.87)^2+(0.13)^2-(0.87)\times(0.13)}$ is equal to:

(a) $\frac{1}{2}$ (b) 2

(c) 1 (d) $2\frac{1}{2}$

**[SSC, 2010]**

**138.** If $x^2 + y^2 - 2x + 6y + 10 = 0$, then the value of $(x^2 + y^2)$ is:

(a) 4 (b) 6
(c) 8 (d) 10

**[SSC, 2010]**

**Directions (Q. 139–141):** What value will come in place of the question mark (?) in the following questions? (You are not expected to calculate the exact value)

**139.** 21 + 3.9 × 2.9 + 8.99 = ?

(a) 42 (b) 46
(c) 44 (d) 34
(e) 36

**[IBPS PO/MT, 2013]**

**140.** 22.9889 ÷ ? = 23

(a) 23 (b) 1
(c) $23^2$ (d) 24
(e) None of these

**[IBPS PO/MT, 2013]**

**141.** $10^3 \times 100^3 + 999999999 = 10^? + 10^?$

(a) 6 (b) 9
(c) 7 (d) 10
(e) 12

**[IBPS PO/MT, 2013]**

**Directions (Q. 142–146):** What will come in place of the question mark (?) in the following questions?

**142.** 4003 × 77 – 21015 = ? × 116

(a) 2477 (b) 2478
(c) 2467 (d) 2476
(e) None of these

**[IBPS PO/MT, 2012]**

**143.** (4444 ÷ 40) + (645 ÷ 25) + (3991 ÷ 26) = ?

(a) 280.4 (b) 290.4
(c) 295.4 (d) 285.4
(e) None of these

**[IBPS PO/MT, 2012]**

**144.** $5\frac{17}{37}\times4\frac{51}{52}\times11\frac{1}{7}+2\frac{3}{4}=?$

(a) 303.75 (b) 305.75

(c) $303\frac{3}{4}$ (d) $305\frac{1}{4}$

(e) None of these

**[IBPS PO/MT, 2012]**

**145.** $\frac{5}{8}$ of $4011.33+\frac{7}{10}$ of 3411.22 = ?

(a) 4810 (b) 4980
(c) 4890 (d) 4930
(e) 4850

**[IBPS PO/MT, 2012]**

**146.** 335.01 × 244.99 ÷ 55 = ?

(a) 1490 (b) 1550
(c) 1420 (d) 1590
(e) 1400

**[IBPS PO/MT, 2012]**

**Directions (Q. 147–154):** What will come in the place of question mark (?) in the following questions?

**147.** 3463 × 295 – 18611 = ? + 5883

(a) 997091 (b) 997071
(c) 997090 (d) 999070
(e) None of these

**[IBPS PO/MT, 2011]**

**148.** $(23.1)^2 + (48.6)^2 - (39.8)^2 = ? + 1147.69$

(a) $(13.6)^2$ (b) $\sqrt{12.8}$
(c) 163.84 (d) 12.8
(e) None of these

**[IBPS PO/MT, 2011]**

**149.** $\frac{28}{65}\times\frac{195}{308}\div\frac{39}{44}+\frac{5}{26}=?$

(a) $\frac{1}{3}$ (b) 0.75

(c) $1\frac{1}{2}$ (d) $\frac{1}{2}$

(e) None of these

**[IBPS PO/MT, 2011]**

**150.** 43931.03 ÷ 2111.02 × 401.04 = ?

(a) 8800 (b) 7600
(c) 7400 (d) 9000
(e) 8300

**[IBPS PO/MT, 2011]**

**151.** 59.88 ÷ 12.21 × 6.35 = ?

(a) 10 (b) 50
(c) 30 (d) 70
(e) 90

**[IBPS PO/MT, 2011]**

**152.** $\frac{1}{8}$ of $\frac{2}{3}$ of $\frac{3}{5}$ of 1715 = ?

(a) 80 (b) 85
(c) 90 (d) 95
(e) 75

**[SBI Associates Banks PO, 2011]**

**153.** 25.05 × 123.95 + 388.999 × 15.001 = ?

(a) 900 (b) 8950
(c) 8935 (d) 8975
(e) 8995

**[SBI Associates Banks PO, 2011]**

**154.** 561 ÷ 35.05 × 19.99 = ?

(a) 320 (b) 330
(c) 315 (d) 325
(e) 335

**[SBI Associates Banks PO, 2011]**

**Directions (Q. 155–158):** What will come in the place of question mark (?) in the following questions?

**155.** $(21)^2 - 3717 \div 59 = ? \times 8$

(a) 43.75 (b) 42.25
(c) 45.75 (d) 47.25
(e) None of these

**[IOB PO, 2011]**

**156.** $2\frac{1}{8}-1\frac{1}{16}=?+1\frac{1}{32}-1\frac{9}{64}$

(a) $2\frac{9}{32}$ (b) $1\frac{9}{64}$
(c) $2\frac{5}{32}$ (d) $1\frac{11}{64}$
(e) None of these

**[IOB PO, 2011]**

**157.** $(0.64)^4 \div (0.512)^3 \times (0.8)^4 = (0.8)^{?+3}$

(a) 5 (b) 12
(c) 0 (d) 6
(e) None of these

**[IOB PO, 2011]**

**158.** $\sqrt{15^2 \times 12 \div 9 - 125 + 21} = ?$

(a) 18 (b) 24
(c) 196 (d) 56
(e) 14

**[IOB PO, 2011]**

**Directions (Q. 159–161):** What approximate value will come in the place of the question mark (?) in the following questions? (You are not expected to calculate the exact value.)

**159.** 7441 ÷ 34 × 12 = ? × 9 + 110

(a) 420 (b) 280
(c) 590 (d) 350
(e) 220

**[IOB PO, 2011]**

**160.** $\frac{989}{34} \div \frac{65}{869} \times \frac{515}{207} = ?$

(a) 840 (b) 920
(c) 970 (d) 780
(e) 1000

**[IOB PO, 2011]**

**161.** $(32.13)^2 + (23.96)^2 - (17.11)^2 = ?$

(a) 1270 (b) 1420
(c) 1450 (d) 1360
(e) 1310

**[IOB PO, 2011]**

**Directions (Q. 162–165):** What will come in the place of question mark (?) in the following questions?

**162.** 23 × 15 – 60 + ? ÷ 31 = 292

(a) 218 (b) 186
(c) 217 (d) 201
(e) None of these

**[Indian Bank PO, 2010]**

**163.** $3\frac{3}{4}+4\frac{2}{5}-3\frac{1}{8}=?$

(a) $4\frac{1}{40}$ (b) $5\frac{1}{40}$
(c) $6\frac{1}{40}$ (d) $5\frac{3}{10}$
(e) None of these

**[Indian Bank PO, 2010]**

**164.** $\frac{343 \times 49}{216 \times 16 \times 81} = ?$

(a) $\frac{7^5}{6^7}$ (b) $\frac{7^5}{6^8}$
(c) $\frac{7^6}{6^7}$ (d) $\frac{7^4}{6^8}$
(e) None of these

**[Indian Bank PO, 2010]**

**165.** $\frac{(a-b)^2 - (a+b)^2}{-4a} = \frac{x}{y}$

On simplifying the above mentioned equation, what will be the new equation?

(a) $xy = b$ (b) $bx = y$
(c) $ab = x$ (d) $yb = x$
(e) $ay = x$

**[Corporation Bank PO, 2009]**

## ANSWER KEYS

### Exercise–1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (a) | **3.** (b) | **4.** (c) | **5.** (b) | **6.** (c) | **7.** (b) | **8.** (a) | **9.** (c) | **10.** (a) | **11.** (d) | **12.** (b) | **13.** (c) |
| **14.** (c) | **15.** (c) | **16.** (c) | **17.** (d) | **18.** (b) | **19.** (d) | **20.** (c) | **21.** (d) | **22.** (a) | **23.** (c) | **24.** (c) | **25.** (c) | **26.** (a) |
| **27.** (d) | **28.** (a) | **29.** (c) | **30.** (c) | **31.** (b) | **32.** (a) | **33.** (b) | **34.** (a) | **35.** (a) | **36.** (a) | **37.** (b) | **38.** (b) | **39.** (d) |
| **40.** (b) | **41.** (a) | **42.** (c) | **43.** (c) | **44.** (a) | **45.** (a) | **46.** (c) | **47.** (c) | **48.** (b) | **49.** (c) | **50.** (d) | **51.** (d) | **52.** (c) |
| **53.** (c) | **54.** (b) | **55.** (c) | **56.** (d) | **57.** (c) | **58.** (a) | **59.** (c) | **60.** (b) | **61.** (a) | **62.** (d) | **63.** (c) | **64.** (d) | **65.** (a) |
| **66.** (a) | **67.** (a) | **68.** (b) | **69.** (a) | **70.** (a) | **71.** (b) | **72.** (d) | **73.** (c) | **74.** (c) | **75.** (b) | **76.** (e) | **77.** (c) | **78.** (c) |

### Exercise–2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (a) | **3.** (c) | **4.** (e) | **5.** (c) | **6.** (e) | **7.** (a) | **8.** (a) | **9.** (a) | **10.** (a) | **11.** (c) | **12.** (a) | **13.** (a) |
| **14.** (c) | **15.** (a) | **16.** (a) | **17.** (b) | **18.** (d) | **19.** (d) | **20.** (c) | **21.** (b) | **22.** (b) | **23.** (b) | **24.** (c) | **25.** (d) | **26.** (b) |
| **27.** (c) | **28.** (b) | **29.** (d) | **30.** (b) | **31.** (c) | **32.** (b) | **33.** (d) | **34.** (d) | **35.** (d) | **36.** (e) | **37.** (c) | **38.** (b) | **39.** (c) |
| **40.** (c) | **41.** (b) | **42.** (d) | **43.** (a) | **44.** (c) | **45.** (c) | **46.** (a) | **47.** (b) | **48.** (b) | **49.** (c) | **50.** (a) | **51.** (b) | **52.** (c) |
| **53.** (c) | **54.** (c) | **55.** (c) | **56.** (a) | **57.** (b) | **58.** (a) | **59.** (b) | **60.** (d) | **61.** (b) | **62.** (c) | **63.** (b) | **64.** (d) | **65.** (c) |
| **66.** (a) | **67.** (b) | **68.** (a) | **69.** (b) | **70.** (a) | **71.** (b) | **72.** (c) | **73.** (b) | **74.** (c) | **75.** (b) | **76.** (d) | **77.** (c) | **78.** (d) |
| **79.** (b) | **80.** (d) | **81.** (c) | **82.** (c) | **83.** (c) | **84.** (b) | **85.** (a) | **86.** (d) | **87.** (b) | **88.** (d) | **89.** (c) | **90.** (a) | **91.** (d) |
| **92.** (a) | **93.** (b) | **94.** (a) | **95.** (c) | **96.** (a) | **97.** (d) | **98.** (d) | **99.** (c) | **100.** (d) | **101.** (b) | **102.** (b) | **103.** (d) | **104.** (c) |
| **105.** (c) | **106.** (a) | **107.** (b) | **108.** (a) | **109.** (c) | **110.** (b) | **111.** (b) | **112.** (d) | **113.** (a) | **114.** (c) | **115.** (c) | **116.** (c) | **117.** (a) |
| **118.** (d) | **119.** (b) | **120.** (b) | **121.** (b) | **122.** (d) | **123.** (d) | **124** (a) | **125.** (c) | **126.** (c) | **127.** (c) | **128.** (d) | **129.** (a) | **130.** (a) |
| **131.** (c) | **132.** (b) | **133.** (a) | **134.** (c) | **135.** (a) | **136.** (b) | **137.** (c) | **138.** (d) | **139.** (a) | **140.** (b) | **141.** (b) | **142.** (d) | **143.** (b) |
| **144.** (b) | **145.** (c) | **146.** (a) | **147.** (a) | **148.** (c) | **149.** (d) | **150.** (a) | **151.** (c) | **152.** (b) | **153.** (c) | **154.** (a) | **155.** (d) | **156.** (d) |
| **157.** (c) | **158.** (e) | **159.** (b) | **160.** (c) | **161.** (e) | **162.** (c) | **163.** (b) | **164.** (a) | **165.** (d) | | | | |

## EXPLANATORY ANSWERS

### Exercise-1

**1. (c)** Given expression

$$= \frac{3}{10} \div \frac{3}{7} \text{ of } \left(\frac{23}{10} + \frac{13}{5}\right) + \frac{1}{5} \times \frac{5}{7} - \frac{2}{7}$$

$$= \frac{3}{10} \div \frac{3}{7} \text{ of } \frac{49}{10} + \frac{1}{7} - \frac{2}{7} = \frac{3}{10} \div \frac{21}{10} - \frac{1}{7}$$

$$= \frac{3}{10} \times \frac{10}{21} - \frac{1}{7} = \frac{1}{7} - \frac{1}{7} = 0.$$

**2. (a)** Given expression

$$= 1 + 1 \div \left\{1 + 1 \div \left(\frac{2}{3}\right)\right\}$$

$$= 1 + 1 \div \left\{1 + 1 \times \frac{3}{2}\right\}$$

$$= 1 + 1 \div \left\{1 + \frac{3}{2}\right\} = 1 + 1 \div \frac{5}{2}$$

$$= 1 + 1 \times \frac{2}{5} = 1 + \frac{2}{5} = \frac{7}{5}.$$

**3. (b)** Given expression

$$= 48 \div 12 \times \left(\frac{9}{8} \text{ of } \frac{4}{3} \div \frac{3}{4} \text{ of } \frac{2}{3}\right)$$

$$= \frac{48}{12} \times \left\{ \left( \frac{9}{8} \times \frac{4}{3} \right) \div \left( \frac{3}{4} \times \frac{2}{3} \right) \right\}$$

$$= \frac{48}{12} \times \left( \frac{3}{2} \times 2 \right) = 4 \times 3 = 12.$$

**4. (c)** Given expression

$$= 2 \div \left[ 2 + 2 \div \left\{ 2 + 2 \div \left( 2 + \frac{2}{3} \right) \right\} \right]$$

$$= 2 \div \left[ 2 + 2 \div \left\{ 2 + 2 \times \frac{3}{8} \right\} \right]$$

$$= 2 \div \left[ 2 + 2 \div \frac{11}{4} \right] = 2 \div \left[ 2 + 2 \times \frac{4}{11} \right]$$

$$= 2 \div \frac{30}{11} = 2 \times \frac{11}{30} = \frac{11}{15}.$$

**5. (b)** Let the missing figure = $x$.

$$\frac{15}{2} - \left[ \frac{9}{4} \div \left\{ \frac{5}{4} - x \left( \frac{3}{2} - \frac{1}{3} - \frac{1}{6} \right) \right\} \right] = 3$$

$$\frac{15}{2} - \left[ \frac{9}{4} \div \left\{ \frac{5}{4} - x \right\} \right] = 3$$

$$\frac{15}{2} - 3 = \frac{9/4}{5/4 - x}$$

$$\frac{9}{2} = \frac{9}{5 - 4x} \quad 5 - 4x = 2$$

$$x = \frac{3}{4}.$$

**6. (c)** We know that $\dfrac{a^3 - b^3}{a^2 + ab + b^2} = a - b$

∴ The given expression = 0.8 − 0.5 = 0.3.

**8. (a)** Given expression

= 1 − [2 − {5 − (4 − 1)}]

= 1 − [2 − {5 − 3}]

= 1 − [2 − 2] = 1 − 0 = 1.

**9. (c)** Given expression

$$= 3 \div \left[ 3 \div \left\{ 2 \div \frac{34}{13} \right\} \right]$$

$$= 3 \div \left[ 3 \div \left\{ 2 \times \frac{13}{34} \right\} \right] = 3 \div \left[ 3 \times \frac{17}{13} \right]$$

$$= 3 \div \frac{51}{13} = 3 \times \frac{13}{51} = \frac{13}{17}.$$

**10. (a)** Given expression

$$= \frac{(69842)^2 - (30158)^2}{69842 - 30158}$$

$$= \frac{(69842 - 30158)(69842 + 30158)}{69842 - 30158}$$

= 100000.

**11. (d)** Given expression

$$= \frac{\frac{15}{7} - \frac{5}{2}}{\frac{9}{4} + \frac{8}{7}} \div \frac{1}{2 + \frac{1}{2 + \frac{2}{3}}}$$

$$= \frac{-5}{14} \times \frac{28}{95} \div \frac{1}{2 + \frac{3}{8}}$$

$$= \frac{-2}{19} \div \frac{8}{19} = \frac{-2}{19} \times \frac{19}{8} = \frac{-1}{4}.$$

**12. (b)** The given expression

= 2.75 − 2.25 = 0.50.

**13. (c)** Given expression

$$= \frac{\frac{1}{2} \times \frac{1}{4} + 20}{2 + 20} = \frac{161}{8} \times \frac{1}{22} = \frac{161}{176}.$$

**14. (c)** Given expression

$$= \frac{(0.53)^2 - 2 \times 0.53 \times 0.41 + (0.41)^2}{0.12}$$

$$= \frac{(0.53 - 0.41)^2}{0.12} = \frac{(0.12)^2}{0.12} = 0.12.$$

**15. (c)** Given expression

$$= \frac{(3^2)^2 \times (3 \times 3 \times 2)^4}{3^{16}}$$

$$= \frac{3^4 \times 3^8 \times 2^4}{3^{16}} = \frac{2^4}{3^4} = \frac{16}{81}.$$

**16. (c)** Given expression

$$= 1 + \frac{1}{2 + \frac{1}{\frac{2}{3}}} = 1 + 1 + \frac{1}{2 + \frac{3}{2}}$$

$$= 1 + \frac{1}{\frac{7}{2}} = 1 + \frac{2}{7} = \frac{9}{7}.$$

**17. (d)** Let $x$ be the missing number

$$= 108 \div x \text{ of } \frac{1}{3} + \frac{2}{5} \times 3\frac{3}{4} = 10\frac{1}{2}$$

$$= 108 \div \frac{x}{3} + \frac{2}{5} \times \frac{15}{4} = \frac{21}{2}$$

$$= \frac{3 \times 108}{x} + \frac{3}{2} = \frac{21}{2}$$

$$= \frac{3 \times 108}{x} = \frac{21}{2} - \frac{3}{2}$$

$= \dfrac{3\times 108}{x} = 9$

$x = \dfrac{3\times 108}{9}$

$x = 36.$

**18. (b)** Given expression

$= \dfrac{108+9+3+1}{108} = \dfrac{121}{108} = 1.1203.$

**19. (d)** Let $x$ of $\dfrac{1}{12} = \dfrac{3}{48}$

Then, $x = \dfrac{3}{48}\times 12\dfrac{3}{4}$

**20. (c)** Given expression

$= 1 + \dfrac{1}{1+3} = 1 + \dfrac{1}{4} = \dfrac{5}{4}.$

**21. (d)** $\dfrac{1}{3} = 0.33$ and $\dfrac{7}{8} = 0.875$

$\dfrac{7}{8} = 0.25$ does not lie between 0.33 and 0.875

$\dfrac{23}{24} = 0.96$ which exceeds 0.875

$\dfrac{11}{12} = 0.92$ which exceeds 0.875

$\dfrac{17}{24} = 0.708$ which lies between 0.33 and 0.875.

**22. (a)** Number of $\dfrac{1}{8}$'s $= \dfrac{75}{2}\div\dfrac{1}{8} = \dfrac{75}{2}\times 8 = 300.$

**23. (c)** Out of 5 girls, 1 took part in the camp.

Out of the 8 boys, 1 took part in the camp.

Out of the 13 students, 2 took part in the camp.

$\therefore$ $\dfrac{2}{13}$ of total number of students took part in the camp.

**24. (c)** Given expression

$= \dfrac{15}{2}+\dfrac{1}{2}\div\dfrac{1}{8}-\dfrac{2}{5}\times\dfrac{7}{3}\div\dfrac{15}{8}$ of $\left(\dfrac{7}{5}-\dfrac{4}{3}\right)$

$= \dfrac{15}{2}+4-\dfrac{2}{5}\times\dfrac{7}{3}\div\dfrac{15}{8}$ of $\dfrac{1}{15}$

$= \dfrac{15}{2}+4-\dfrac{2}{5}\times\dfrac{7}{3}\div\dfrac{1}{8}$

$= \dfrac{15}{2}+4-\dfrac{2}{5}\times\dfrac{7}{3}\times\dfrac{8}{1}$

$= \dfrac{15}{2}+4-\dfrac{112}{15} = \dfrac{23}{2}-\dfrac{112}{15}$

$= \dfrac{121}{30} = 4\dfrac{1}{30}.$

**25. (c)** Given expression

$= \dfrac{5}{3}\times\dfrac{7}{5}\times\dfrac{9}{7}\times\ldots\times\dfrac{1003}{1001} = \dfrac{1003}{3}.$

**26. (a)** Given expression

$= \dfrac{1}{6}+\dfrac{1}{24}+\dfrac{1}{60}+\dfrac{1}{120}$

$= \dfrac{20+5+2+1}{120} = \dfrac{28}{120} = \dfrac{7}{30}.$

**27. (d)** Let, $\dfrac{47}{3}\times\dfrac{19}{6}+\dfrac{19}{3} = \dfrac{205}{18} + x$

Then, $x = \dfrac{893}{18}+\dfrac{19}{3}-\dfrac{205}{18}$

$= \dfrac{893+114-205}{18} = \dfrac{802}{18} = 44\dfrac{5}{9}.$

**28. (a)** Given expression

$= 3 \div \left[3\div\left\{2\div\dfrac{34}{13}\right\}\right]$

$= 3 \div \left[3\div\left(2\times\dfrac{13}{34}\right)\right]$

$= 3 \div \left[3\times\dfrac{17}{13}\right] = 3 \times \dfrac{13}{51} = \dfrac{13}{17}.$

**29. (c)** $\dfrac{3}{5} = 0.60$

$\dfrac{3}{4} = 0.75$

$\dfrac{2}{3} = 0.66$

$\therefore$ $\dfrac{3}{4} > \dfrac{2}{3} > \dfrac{3}{5}.$

**30. (c)** Given expression

$= \dfrac{240\times 300}{240} = 300.$

**31. (b)** $\dfrac{3a+2b}{3a-2b} = \dfrac{3\left(\dfrac{a}{b}\right)+2}{3\left(\dfrac{a}{b}\right)-2} = \dfrac{3\left(\dfrac{1}{3}\right)+2}{3\left(\dfrac{1}{3}\right)-2} = \dfrac{3}{-1} = -3.$

**32. (a)** Given expression

$= \dfrac{4}{2}+2\times 2+2\times\dfrac{3}{2} = 2 + 4 + 3 = 9.$

**33. (b)** Let $\dfrac{5}{6}\div\dfrac{6}{7}\times x-\dfrac{8}{9}\div\dfrac{8}{5}+\dfrac{3}{4}\times\dfrac{10}{3} = \dfrac{25}{9}$. Then,

$\dfrac{5}{6}\times\dfrac{7}{6}\times x-\dfrac{8}{9}\times\dfrac{5}{8}+\dfrac{3}{4}\times\dfrac{10}{3} = \dfrac{25}{9}$

or, $\dfrac{35}{36}x-\dfrac{5}{9}+\dfrac{10}{4} = \dfrac{25}{9}$ or, $\dfrac{35}{36}x = \dfrac{25}{9}+\dfrac{5}{9}-\dfrac{5}{2}$

or, $\frac{35}{36}x = \frac{30}{9} - \frac{5}{2}$ or, $\frac{35}{36}x = \frac{60-45}{18}$

or, $x = \frac{15}{18} \times \frac{36}{35}$

$\therefore$ $x = \frac{6}{7}$.

**34.** **(a)** Let, $\frac{9}{2} + \frac{19}{6} + x + \frac{7}{3} = \frac{67}{5}$. Then,

$x = \frac{67}{5} - \left(\frac{9}{2} + \frac{19}{6} + \frac{7}{3}\right)$

$= \frac{67}{5} - 10 = \frac{17}{5} = 3\frac{2}{5}$.

**35.** **(a)** $0.001 = (0.1)^3$; $0.067 = 0.1 \times 0.67$

The given expression

$= \frac{a^3 - b^3}{a^2 + ab + b^2} = a - b$

$= 0.67 - 0.10 = 0.57$.

**36.** **(a)** Let total number of students $= x$

Number of girl students $= \frac{2x}{3}$

Number of boy students $= \frac{x}{3}$

Number of girls who took part in the camp

$= \frac{1}{5}\left(\frac{2x}{3}\right) = \frac{2}{15}x$

Number of boys who took part in the camp

$= \frac{1}{8}\left(\frac{x}{3}\right) = \frac{x}{24}$

Total number of students who took part in the camp

$= \frac{2}{15}x + \frac{x}{24} = \left(\frac{16+5}{120}\right)x = \frac{7}{40}x$.

**37.** **(b)** Let the fraction be $\frac{a}{b}$. Then,

$\left(\frac{a}{b} \times \frac{a}{b}\right) \div \frac{b}{a} = 18\frac{26}{27} = \frac{512}{27}$

or $\left(\frac{a}{b}\right)^3 = \left(\frac{8}{3}\right)^3$

$\therefore$ $\frac{a}{b} = \frac{8}{3} = 2\frac{2}{3}$.

**39.** **(d)** Let $\frac{1}{4} + \frac{1}{6} - x = 3 \times \frac{1}{12}$ then,

$\frac{1}{4} + \frac{1}{6} - x = \frac{1}{4}$ or $x = \frac{1}{6}$.

**40.** **(b)** Let $x$ be the fraction

$\frac{7}{6}x - \frac{6}{7}x = \frac{1}{7} \Rightarrow x = \frac{6}{13}$

The correct answer $= \frac{6}{7}x = \frac{6}{7} \times \frac{6}{13} = \frac{36}{91}$.

**41.** **(a)** $2 + \sqrt{2} + \left[\frac{\sqrt{2} - 2 + 2 + \sqrt{2}}{(\sqrt{2})^2 - (2)^2}\right]$

$= 2 + \sqrt{2} + \frac{2\sqrt{2}}{2-4}$

$= 2 + \sqrt{2} - \sqrt{2} = 2$.

**42.** **(c)** $\frac{1}{2} = 0.50000$ $\cdots(1)$

$\frac{1}{2.3} = 0.16667$ $\cdots(2)$ (divide (1) by 3)

$\frac{1}{2.3.4} = 0.04167$ $\cdots(3)$ (divide (2) by 4)

$\frac{1}{2.3.4.5} = 0.00833$ $\cdots(4)$ (divide (3) by 5)

Adding, we have 0.71667 or 0.717 up to three places.

**43.** **(c)** Putting $x$ in place of?

$\frac{x \div 12}{0.2 \times 3.6} = 2$ or, $x \div 12 = 2 \times 0.2 \times 3.6$

$\Rightarrow$ $x = 2 \times 0.2 \times 3.6 \times 12$ or, $x = 17.28$.

**44.** **(a)** Substituting $x$ for?, we get

$\sqrt{x \times 7} \times 18 = 84$

or, $\sqrt{x \times 7} = \frac{84}{18}$ or, $(\sqrt{x \times 7})^2 = \left(\frac{84}{18}\right)^2$

or, $x \times 7 = \frac{84 \times 84}{18 \times 18}$ or, $x = \frac{84 \times 84}{18 \times 18 \times 7} = 3.11$.

**45.** **(a)** Sum $= \frac{7}{4} + \frac{7}{3} + \frac{41}{12} + \frac{26}{5} + \frac{13}{6}$

$= \frac{105 + 140 + 205 + 312 + 130}{60}$

$= \frac{892}{60} = 14\frac{13}{15}$

which is nearer to 15 than 14

Difference : $15 - 14\frac{13}{15} = \frac{2}{15}$.

**46.** **(c)** Taking the quotient 2, $y$ and 7, we get $2y = 7$, which gives the quotient as 3

$\therefore$ $y = 3$. Substituting the value of $y$, we get

$2\frac{3}{x} \times 3\frac{1}{2} = 7\frac{3}{4}$

Now, $\dfrac{7\frac{3}{4}}{3\frac{1}{2}} = 2\dfrac{3}{x} \Rightarrow 2\dfrac{3}{14} = \dfrac{3}{x}$

$\therefore\ x = 14,\ y = 3.$

**47. (c)** Let $x$ be the fraction

$x \times x \div \left(\dfrac{1}{x}\right)^2 = 3\dfrac{13}{81} \Rightarrow x^4 = \dfrac{256}{81} = \left(\dfrac{4}{3}\right)^4$

$\therefore\ x = \dfrac{4}{3}.$

**48. (b)** Substituting $x = 7$ and $y = 5$, we get

$7 \times 5 = (7 + 2)^2(5 - 2) = (9)^2 \times 3 = 243.$

**49. (c)** Given that $m^n = 121 \Rightarrow m^n = 11^2$

Hence, $m = 11$, $n = 2$. Substituting these values $(m - 1)^{n+1} = (11 - 1)^{2+1} = 10^3 = 1000.$

**51. (d)** $x \times \dfrac{17}{8} - x \times \dfrac{8}{17} = 225$ or, $\dfrac{225}{136}x = 225$

$\therefore\ x = 136.$

**52. (c)** $\dfrac{1}{1.2} + \dfrac{1}{2.3} + \dfrac{1}{3.4} + \ldots + \dfrac{1}{9.10}$

$= \left(1 - \dfrac{1}{2}\right) + \left(\dfrac{1}{2} - \dfrac{1}{3}\right) + \left(\dfrac{1}{3} - \dfrac{1}{4}\right) + \ldots + \left(\dfrac{1}{9} - \dfrac{1}{10}\right) = 1 - \dfrac{1}{10} = \dfrac{9}{10}$

**53. (c)** Putting $x$ for?

$\sqrt{1296} \times 2.25 = x^2$ or, $36 \times 2.25 = x^2$

or, $x = \sqrt{36 \times 2.25}$ or, $x = 6 \times 1.5$

$\therefore\ x = 9.$

**54. (b)** $x \times x \div \dfrac{1}{x} = 18\dfrac{26}{27}$ or, $x^3 = \dfrac{512}{27}$

$\therefore\ x^3 = \left(\dfrac{8}{3}\right)^3$ and so $x = \dfrac{8}{3} = 2\dfrac{2}{3}.$

**55. (c)** Given that $\dfrac{a}{a+b} = \dfrac{17}{23}$

i.e., if $a = 17$, then $a + b = 23$ or, $b = 6$

$a - b = 17 - 6 = 11$

$\therefore\ \dfrac{a+b}{a-b} = \dfrac{23}{11}.$

**57. (c)** $\dfrac{3}{4}x - \dfrac{3}{14}x = 150$ or, $\dfrac{15}{28}x = 150$

$\therefore\ x = \dfrac{150 \times 28}{15} = 280.$

**58. (a)** Given product

$= \dfrac{5}{3} \times \dfrac{7}{5} \times \dfrac{9}{7} \times \ldots \times \dfrac{1003}{1001} = \dfrac{1003}{3}.$

**59. (c)** $\sqrt{2^n} = 64$ or, $(2^n)^{1/2} = 2^6$

$\Rightarrow \dfrac{n}{2} = 6 \Rightarrow n = 12.$

**60. (b)** $10^y = \sqrt{10^{2y}} = \sqrt{25} = 5.$

**61. (a)** Putting $x$ for? and solving

$11\dfrac{1}{3} \times 4\dfrac{8}{10} \div x = 22\dfrac{2}{3}$

or, $11\dfrac{1}{3} \times 4\dfrac{8}{10} = 22\dfrac{2}{3}x$

or, $x = \dfrac{11\frac{1}{3} \times 4\frac{8}{10}}{22\frac{2}{3}}$ or $x = \dfrac{1}{2} \times 4\dfrac{8}{10}$

$\therefore\ x = \dfrac{1}{2} \times \dfrac{48}{10} = \dfrac{24}{10} = 2.4.$

**62. (d)** $\dfrac{a^{1/2} + a^{-1/2}}{1-a} + \dfrac{1 - a^{-1/2}}{1+\sqrt{a}}$

$= \dfrac{a^{1/2} + a^{-1/2}}{(1+a^{1/2})(1-a^{1/2})} + \dfrac{1 - a^{-1/2}}{1+a^{1/2}}$

$= \dfrac{a^{1/2} + a^{-1/2} + (1 - a^{-1/2})(1 - a^{1/2})}{(1+a^{1/2})(1-a^{1/2})}$

$= \dfrac{a^{1/2} + a^{-1/2} + 1 - a^{-1/2} - a^{1/2} + 1}{1-a}$

$= \dfrac{2}{1-a}.$

**63. (c)** $\dfrac{1}{a} + \dfrac{1}{b} = \dfrac{a+b}{ab} = \dfrac{\sqrt{a^2 + b^2 + 2ab}}{ab}$

$= \dfrac{\sqrt{45 + 2 \times 18}}{18} = \pm\dfrac{9}{18} = \pm\dfrac{1}{2}.$

**64. (d)** $\dfrac{a^2 + b^2}{c^2 + d^2} = \dfrac{ab}{cd}$ or, $\dfrac{a^2 + b^2}{c^2 + d^2} = \dfrac{2ab}{2cd}$

or, $\dfrac{a^2 + b^2 + 2ab}{a^2 + b^2 - 2ab} = \dfrac{c^2 + d^2 + 2cd}{c^2 + d^2 - 2cd}$

[by componendo and dividendo]

or, $\left(\dfrac{a+b}{a-b}\right)^2 = \left(\dfrac{c+d}{c-d}\right)^2$

$\therefore\ \dfrac{a+b}{a-b} = \dfrac{c+d}{c-d}.$

**65. (a)** Putting $x$ for? and solving

$(1.06 + 0.04)^2 - x = 4 \times 1.06 \times 0.04$

Here, $1.06 = a$ and $0.04 = b$

$\therefore\ (a+b)^2 - x = 4ab$

$\therefore\ x = (a+b)^2 - 4ab = (a-b)^2 = (1.06 - 0.04)^2$

$= (1.02)^2 = 1.0404.$

**66. (a)** Let the total score be $x$ runs, such that

$\frac{2}{9}x - \frac{2}{9}\times\left(x - \frac{2}{9}x\right) = 8$ or, $\frac{2}{9}x - \frac{2}{9}\times\frac{7}{9}x = 8$

or, $\frac{2}{9}x\times\frac{2}{9} = 8$ or, $x = 162.$

**67. (a)** $\left(\frac{1}{64}\right)^0 + (64)^{-1/2} + (-32)^{4/5}$

$= 1 + (8^2)^{-1/2} + (-1\times 32)^{4/5}$

$= 1 + 8^{-1} + [(-1)^{4/5} \times (32)^{4/5}]$

$= 1 + 8^{-1} + [((-1)^2)^{2/5} \times (2^5)^{4/5}]$

$= 1 + \frac{1}{8} + [1 \times 16] = 17\frac{1}{8}.$

**68. (b)** $x = \frac{(64)^2 - 9\times 121}{121\times 64}\times\frac{8\times 11}{(8)^2 + 3\times 11}$

$x = \frac{(64)^2 - 3\times 3\times 11\times 11}{11\times 11\times 8\times 8}\times\frac{8\times 11}{64+33}$

or, $x = \frac{(64+33)(64-33)}{88}\times\frac{1}{64+33}$

or, $x = \frac{31}{88}.$

**69. (a)** Let the number be 1

$\therefore\ \frac{1}{3}$ of $1 = \frac{1}{3}$ and, $\frac{1}{4}$ of $1 = \frac{1}{4}$

$\therefore\ \frac{1}{3} - \frac{1}{4} = \frac{4-3}{12} = \frac{1}{12}$

$\therefore$ Number $12 \div \frac{1}{12} = 144.$

**70. (a)** L.C.M. of 7, 8, 16 and 35 = 560

$\therefore\ \frac{5}{8} = \frac{5\times 70}{8\times 70} = \frac{350}{560}$

$\frac{21}{35} = \frac{21\times 16}{35\times 16} = \frac{336}{560}$

$\frac{9}{16} = \frac{9\times 35}{16\times 35} = \frac{315}{560}$

and, $\frac{6}{7} = \frac{6\times 80}{7\times 80} = \frac{480}{560}$

$\therefore$ Difference between the largest and the smallest fractions

$= \frac{6}{7} - \frac{9}{16} = \frac{480}{560} - \frac{315}{560} = \frac{165}{560} = \frac{33}{112}.$

**71. (b)** Let the money with the man at first be ₹1

$\therefore$ Money spent $= \frac{5}{6}$ of $1 =$ ₹ $\frac{5}{6}$

$\therefore$ Remaining money $= 1 - \frac{5}{6} =$ ₹ $\frac{1}{6}$

and money earned $= \frac{1}{2}$ of ₹ $\frac{1}{6} =$ ₹ $\frac{1}{12}$

$\therefore$ Total money with him now

$= \frac{1}{6} + \frac{1}{12} =$ ₹ $\frac{3}{12} =$ ₹ $\frac{1}{4}$

$\therefore\ \frac{1}{4}$ part of his money is with him now.

**72. (d)** Let the monthly income of Manmohan be ₹1

$\therefore$ Pocket money $= \frac{1}{5}$ of ₹1 = ₹ $\frac{1}{5}$

Remainder $= 1 - \frac{1}{5} =$ ₹ $\frac{4}{5}$

$\therefore$ Other expenses $= \frac{4}{5}$ of ₹ $\frac{4}{5} =$ ₹ $\frac{16}{25}$

$\therefore$ Saving $= \frac{4}{5} - \frac{16}{25} =$ ₹ $\frac{4}{25}$

$\therefore$ Monthly income $= 48 \div \frac{16}{25} =$ ₹300.

**73. (c)** Let the number be 1.

$\therefore\ \frac{4}{5}$ of $1 = \frac{4}{5}$ and, $\frac{3}{4}$ of $1 = \frac{3}{4}$

$\therefore$ Difference $= \frac{4}{5} - \frac{3}{4} = \frac{1}{20}$

$\therefore$ Number $= 4 \div \frac{1}{20} = 80.$

**74. (c)** $\because\ \frac{2}{3}$ part = 96

$\therefore\ \frac{3}{4}$ part $= 96 \times \frac{3}{2}\times\frac{3}{4} = 108.$

**75. (b)** Journey completed by aeroplane and train

$= \frac{2}{15} + \frac{2}{5} = \frac{2+6}{15} = \frac{8}{15}$

$\therefore$ Remaining journey $= 1 - \frac{8}{15} = \frac{7}{15}$

$\therefore$ He completed $\frac{7}{15}$ part of his journey by taxi.

**76. (e)** $\left(1-\frac{1}{2}\right)\left(1-\frac{1}{3}\right)\left(1-\frac{1}{4}\right)\ldots\left(1-\frac{1}{70}\right)=\frac{x}{70}$

$\therefore\ \frac{1}{2}\times\frac{2}{3}\times\frac{3}{4}\times\ldots\frac{69}{70}=\frac{x}{70}$

$\therefore\ \frac{1}{70}=\frac{x}{70}\qquad \therefore\ x = 1.$

**77. (c)** $\frac{1.073\times1.073-0.927\times0.927}{1.073-0.927}+\frac{(3^4)^4\times(9)^6}{(27)^7\times(3)^9}$

$=\frac{(1.073)^2-(0.927)^2}{1.073-0.927}+\frac{(3^4)^4\times(3^2)^6}{(3^3)^7\times(3)^9}$

$=\frac{(1.073+0.927)(1.073-0.927)}{1.073-0.927}+\frac{3^{28}}{3^{30}}$

$= 2+\frac{1}{3^2} = 2+\frac{1}{9} = 2\frac{1}{9}.$

**78. (c)** $\frac{2^{1/2}\times3^{1/3}\times4^{1/4}}{10^{-1/5}\times5^{3/5}}\div\frac{3^{4/3}\times5^{-7/5}}{4^{-3/5}\times6}$

$=\frac{2^{1/2}\times3^{1/3}\times(2^2)^{1/4}\times10^{1/5}}{5^{3/5}}\div\frac{3^{4/3}\times4^{3/5}}{5^{7/5}\times6}$

$=\frac{2^{1/2}\times3^{1/3}\times2^{1/2}\times2^{1/5}\times5^{1/5}}{5^{3/5}}\times\frac{5^{7/5}\times2\times3}{3^{4/3}\times2^{6/5}}$

$=2^{\frac{1}{2}+\frac{1}{2}+\frac{1}{5}-\frac{6}{5}+1}\times3^{\frac{1}{3}-\frac{4}{3}+1}\times5^{\frac{1}{5}-\frac{3}{5}+\frac{7}{5}}$

$= 2^1\times3^0\times5^1 = 2\times5 = 10.$

## EXERCISE–2
## (BASED ON MEMORY)

**1. (b)** $\frac{x+2x}{y+1.5y}=\frac{7}{10}\Rightarrow\frac{3x}{2.5y}=\frac{7}{10}\Rightarrow\frac{x}{y}=\frac{7\times2.5}{10\times3}=\frac{7}{12}$

**2. (a)** $? = 16^{7.5}\div8^{3.5}\div2^{7.5}$

$=(2)^{30}\div(2)^{10.5}\div(2)^{7.5} = 2^{30-10.5-7.5} = 2^{12} = (8)^4$

**3. (c)** $\therefore\ (a)^c\times(b)^a\times?=0\qquad\therefore\ ?=0$

**4. (e)** 457

**6. (e)** 59

**8. (a)** Suppose that the number is $k$

Then, we have

$\frac{3}{5}\times\frac{2}{3}\times k-\frac{2}{5}\times\frac{1}{4}\times k=288$

or, $\frac{2}{5}k-\frac{1}{10}k=288$ or, $\frac{3}{10}k=288$ or, $k=\frac{288\times10}{3}=960$

**9. (a)** $\frac{2}{3}$ of 99 − $\frac{3}{4}$ of 52 = 66 − 39 = 27

**10. (a)** Suppose original fraction $=\frac{x}{y}$.

Then, $\frac{5x}{6y}=\frac{15}{22}\qquad\therefore\ \frac{x}{y}=\frac{15}{22}\times\frac{6}{5}=\frac{9}{11}$

**11. (c)** $? = \sqrt{928\times58}=\sqrt{29\times32\times29\times2}$

$=\sqrt{(29)^2\times(8)^2}=29\times8=232$

**12. (a)** $3^{3.5}\times21^2\times42^{2.5}\div2^{2.5}\times7^{3.5}$

$=\frac{3^{3.5}\times21^2\times42^{2.5}\times7^{3.5}}{2^{2.5}}$

$=\frac{\left(3^{3.5}\times7^{3.5}\right)\times21^2\times\left(21^{2.5}\times2^{2.5}\right)}{2^{2.5}}$

$=21^{3.5}\times21^2\times21^{2.5}=21^{(3.5+2+2.5)}=21^8$

**13. (a)** $x+y=\frac{\sqrt5+\sqrt3}{\sqrt5-\sqrt3}+\frac{\sqrt5-\sqrt3}{\sqrt5+\sqrt3}$

$=\frac{\left(\sqrt5+\sqrt3\right)^2+\left(\sqrt5-\sqrt3\right)^2}{\left(\sqrt5-\sqrt3\right)\left(\sqrt5+\sqrt3\right)}$

$=\frac{5+3+2\sqrt{15}+5+3-2\sqrt{15}}{5-3}=\frac{16}{2}=8$

**14. (c)** $\frac{1}{\sqrt2+\sqrt3-\sqrt5}+\frac{1}{\sqrt2-\sqrt3-\sqrt5}$

$=\frac{\sqrt2-\sqrt3-\sqrt5+\sqrt2+\sqrt3-\sqrt5}{\left[\left(\sqrt2-\sqrt5\right)+\sqrt3\right]}\times\left[\left(\sqrt2-\sqrt5\right)-\sqrt3\right]$

$=\frac{2\sqrt2-2\sqrt5}{\left(\sqrt2-\sqrt5\right)^2-\left(\sqrt3\right)^2}$

$=\frac{2\left(\sqrt2-\sqrt5\right)}{2+5-2\sqrt{10}-3}$

$$= \frac{2\left(\sqrt{2}-\sqrt{5}\right)}{2\left(2-\sqrt{10}\right)}$$

$$= \frac{\sqrt{2}-\sqrt{5}}{\sqrt{2}\left(\sqrt{2}-\sqrt{5}\right)} = \frac{1}{\sqrt{2}}$$

**15. (a)** $5\frac{3}{*} \times 3\frac{1}{2} = 19$

$$\Rightarrow \quad \frac{5*+3}{*} \times \frac{7}{2} = 19$$

$$\Rightarrow \frac{5*+3}{*} = \frac{38}{7} \Rightarrow * = 7$$

**16. (a)** Given expression $= \frac{1}{2} \times \frac{2}{3} \times \frac{3}{4} \times ... \times \frac{99}{100}$

$$= \frac{1}{100} = 0.01$$

**17. (b)** $\left[\frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}-\sqrt{3}}\right]^2 + \left[\frac{\sqrt{5}-\sqrt{3}}{\sqrt{5}+\sqrt{3}}\right]^2$

$$= \left[\frac{(\sqrt{5}+\sqrt{3})(\sqrt{3}+\sqrt{3})}{(\sqrt{5}-\sqrt{3})(\sqrt{5}+\sqrt{3})}\right]^2 + \left[\frac{(\sqrt{5}-\sqrt{3})(\sqrt{5}-\sqrt{3})}{(\sqrt{5}+\sqrt{3})(\sqrt{5}-\sqrt{3})}\right]^2$$

$$= \left[\frac{5+3+2\sqrt{15}}{5-3}\right]^2 + \left[\frac{5+3-2\sqrt{15}}{5-3}\right]^2$$

$$= \left[4+\sqrt{15}\right]2 + \left[4-\sqrt{15}\right]2$$

$= 16 + 15 + 8\sqrt{15} + 16 + 15 - 8\sqrt{15}$

$= 16 + 15 + 16 + 15$ or, 62.

**18. (d)** $25^{25} = (26 - 1)^{25}$

$= 26^{25} + {}^{25}C_1 \times 26^{24} \times (-1)^1$

$+ {}^{25}C_2 \times 26^{23} \times (-1)^2 + \cdots + (-1)^{25}$

[using Binomial theorem]

Now, all the terms are divisible by 26 except the last term $(-1)^{25}$. So, the remainder is $26 - 1 = 25$.

**19. (d)** Let $x = \sqrt{6+\sqrt{6+\sqrt{6+\cdots}}}$

On squaring, we get

$x^2 = 6 + x$ or, $x^2 - x - 6 = 0$

or, $(x - 3)(x + 2) = 0$ or, $x = 3, -2$

But –ve value cannot be accepted.

$\therefore$ $x = 3$.

**21. (b)** Given expression $= (2^4)^{0.16} \times (2^4)^{0.04} \times (2)^{0.2}$

$= 2^{0.64} \times 2^{0.16} \times 2^{0.2}$

$= 2^1 = 2$.

**22. (b)** Number $= 269 \times 68 = 18292$

$= 67 \times 273 + 1$.

**23. (b)** $\frac{14}{15} \times \frac{35}{24} = \frac{7}{6}$

**25. (d)** $\frac{5}{3} \div \frac{2}{7} \times \frac{*}{7} = \frac{5}{4} \times \frac{2}{3} \div \frac{1}{6}$

or, $\frac{5}{3} \times \frac{7}{2} \times \frac{*}{7} = \frac{5}{4} \times \frac{2}{3} \times \frac{6}{1}$

or, $* = \frac{5}{4} \times \frac{2}{3} \times \frac{6}{1} \times \frac{3}{5} \times \frac{2}{7}$

Hence, $* = 6$.

**26. (b)** Suppose that certain amount is ₹$x$

Then, $\left(x - \frac{3}{16}x - \frac{x}{4}\right) = 81$

or, $16x - 3x - 4x = 81 \times 16$

or, $x = \frac{81 \times 16}{9} = 144$

Hence, B gets $= 144 \times \frac{1}{4} =$ ₹36.

**27. (c)** Required greatest number is H.C.F. of (989 – 5) and (1327 – 7)

Hence, H.C.F. of 989 and 1320 is 24.

**28. (b)** $1 * 2 = 1 + 2 \times 6 = 1 + 12 = 13$

$(1 * 2) * 3 = 13 * 3 = 13 + 3 \times 6 = 31$.

**29. (d)** The given expression

$$= \frac{2}{1+\frac{2}{2-1}} \times \frac{3}{\frac{5}{4} \div \frac{5}{4}} = \frac{2}{3} \times 3 = 2.$$

**30. (b)** $x * y = x^2 + y^2 - xy$

$\therefore$ $9 * 11 = (9)^2 + (11)^2 - 9 \times 11$

$= 81 + 121 - 99 = 103$.

**31. (c)** Man has $1 - \left(\frac{1}{3} + \frac{2}{3} + \frac{1}{5}\right) = \frac{1}{15}$

$\therefore$ Man's income $= 400 \times 15 =$ ₹6000.

**32. (b)** $2 * 3 + 3 * 4$

$= [2(2) + 3(3)] + [2(3) + 3(4)]$

$= [4 + 9] + [6 + 12] = 31$.

**33. (d)** Given expression

$$= \left[\left\{(2^9)^{1/6}\right\}^{1/3}\right]^4 \times \left[\left\{(2^9)^{1/3}\right\}^{1/6}\right]^4$$

$= (2^{1/2})^4 \times (2^{1/2})^4 = 2^2 \times 2^2 = 2^4$.

**34. (d)** Given expression

$$= \sqrt{10+\sqrt{25+\sqrt{108+\sqrt{154+15}}}} = \sqrt{10+\sqrt{25+\sqrt{108+13}}}$$

$$= \sqrt{10+\sqrt{25+11}} = \sqrt{10+6} = \sqrt{16} = 4.$$

**35.** **(d)** $25^{7.5} \times 5^{2.5} \div 125^{1.5} = 5^{?}$

or, $5^{2\times 7.5} \times 5^{2.5} \div 5^{3\times 1.5} = 5^{?}$

or, $5^{15} \times 5^{2.5} \div 5^{4.5} = 5^{?}$

or, $5^{17.5} \times \frac{1}{5^{4.5}} = 5^{?}$ or, $5^{13} = 5^{?}$

or, ? = 13.

**36.** **(e)** Let the number be $x$

Then, $\frac{2}{5}\times\frac{1}{3}\times\frac{3}{7}\times x = 15$

or, $\frac{2x}{35} = 15$ or, $x = \frac{15\times 35}{2}$

$\therefore$ 40% of $x = \frac{40}{100}\times\frac{15\times 35}{2} = 105.$

**37.** **(c)** Required number

$= \frac{2}{5} \times 200 - \frac{3}{5} \times 125 = 80 - 75 = 5.$

**38.** **(b)** $\frac{2}{3} = \frac{2\times 165}{3\times 165} = \frac{330}{495}$

$\frac{3}{5} = \frac{3\times 99}{5\times 99} = \frac{297}{495}$

$\frac{7}{9} = \frac{7\times 55}{9\times 55} = \frac{385}{495}$

$\frac{9}{11} = \frac{9\times 45}{11\times 45} = \frac{405}{495}$

$\frac{8}{9} = \frac{8\times 55}{9\times 55} = \frac{440}{495}$

Ascending order $\frac{3}{5}, \frac{2}{3}, \frac{7}{9}, \frac{9}{11}, \frac{8}{9}$.

**39.** **(c)** $((47)^{1/2})^{15} \div ((47)^{1/2})^{3} \times ((47)^{1/2})^{-6}$

$= \left(\sqrt{47}\right)^{?} = \left(\sqrt{47}\right)^{15} \div \left(\sqrt{47}\right)^{3} \times \left(\sqrt{47}\right)^{-6} = \left(\sqrt{47}\right)^{?}$

$\Rightarrow \left(\sqrt{47}\right)^{15-3-6} = \left(\sqrt{47}\right)^{?}$

$\therefore$ ? = 6.

**41.** **(b)** $? = \frac{(10008.99)^2}{10009.001}\times\sqrt{3589} \times 0.4987$

$\approx (10009) \times \sqrt{3600} \times 0.50$

$\approx (10009) \times 60 \times 0.50 \approx 300000.$

**43.** **(a)** Difference between two lowest numbers

$= 16 - 7 = 9$

Difference between two highest numbers

$= 91 - 89 = 2$

$\therefore$ Product of these two numbers $= 9 \times 2 = 18.$

**44.** **(c)** $\frac{1}{5}\ I = \frac{5}{8}\ II \quad \therefore \quad \frac{I}{II} = \frac{25}{8}$ ...(1)

$I + 35 = 4\ II$ or, $\frac{25}{8}\ II + 35 = 4\ II$

$\therefore\ II = 40.$

**45.** **(c)** Suppose, there were $x$ packages in the van before delivery.

$\therefore$ After first delivery, the number of packages in the van

$= x - \frac{2}{5}x = \frac{3}{5}x$

After second delivery, the number of packages in the van

$= \frac{3}{5}x - 3 = \frac{3x-15}{5}$

$\therefore \quad \frac{3x-15}{5} = \frac{x}{2}$ (Given)

$\Rightarrow \quad x = 30.$

**46.** **(a)** $(6\times\sqrt[3]{5})^3 = 216 \times 5 = 1080$

$(8\times\sqrt[3]{2})^3 = 512 \times 2 = 1024$

$(2\times\sqrt[3]{130})^3 = 8 \times 130 = 1040$

$(\sqrt[3]{900})^3 = 900.$

**47.** **(b)** $x = 2 + 2^{2/3} + 2^{1/3}$

$\Rightarrow \quad (x - 2) = 2^{2/3} + 2^{1/3}$

$\Rightarrow \quad (x - 2)^3 = (2^{2/3} + 2^{1/3})^3$

$= 4 + 2 + 3 \times 2^{2/3} \times 2^{1/3}\ [2^{2/3} + 2^{1/3}]$

$= 6 + 3 \times 2\ (x - 2)$

$\Rightarrow \quad (x - 2)^3 = 6 + 6x - 12 = 6x - 6$

$\Rightarrow \quad x^3 - 8 - 6x\ (x - 2) = 6x - 6$

$\Rightarrow \quad x^3 - 6x^2 + 6x = 2.$

**48.** **(b)** $\sqrt[3]{\frac{.9\times .9\times .9\times 100}{.16\times .16\times .16\times 100}} = \frac{.9}{.16} = 5.625.$

**49.** **(c)** $\sqrt{80} = \sqrt{16\times 5} = 4\sqrt{5} = 2.236.$

**50.** **(a)** $21952 = 4 \times 4 \times 4 \times 7 \times 7 \times 7$

$\therefore \sqrt[3]{21952} = 4 \times 7 = 28.$

**51.** **(b)** $\frac{1}{\sqrt{5}-\sqrt{3}} = \frac{1}{\sqrt{5}-\sqrt{3}}\times\frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}+\sqrt{3}}$

$= \frac{\sqrt{5}+\sqrt{3}}{5-3} = \frac{2.2361+1.7321}{2}$

$= \frac{3.9682}{2} = 1.9841.$

**52. (c)** $\sqrt{272^2-128^2} = \sqrt{(272+128)(272-128)}$

$= \sqrt{400\times144}$

$= 20 \times 12 = 240.$

**53. (c)** $\sqrt{0.9} = \sqrt{\frac{9}{10}} = \frac{3}{10}\times\frac{\sqrt{10}}{\sqrt{10}}$

$= \frac{3\times3.16}{10} = \frac{9.48}{10} = 0.94.$

**54. (c)** $\frac{0.342\times0.684}{0.000342\times0.000171} = \frac{342\times684\times10^6}{342\times171}$

$= 4 \times 10^6$

Square root of $4 \times 10^6 = 2 \times 10^3 = 2000.$

**55. (c)** $\sqrt[3]{175.616} = \sqrt[3]{\frac{175616}{10000}} = \frac{56}{10} = 5.6$

$\sqrt[3]{0.175616} = \sqrt[3]{\frac{175616}{1000000}} = \frac{56}{100} = 0.56$

$\sqrt[3]{0.000175616} = \sqrt[3]{\frac{175616}{1000000000}} = \frac{56}{1000}$

$= 0.056$

$\therefore$ Required answer $= 5.6 + 0.56 + 0.056 = 6.216.$

**56. (a)** $\sqrt{8}+2\sqrt{32}-\sqrt[3]{128}+\sqrt[4]{50}$

$= 2\sqrt{2} + 2 \times 4\sqrt{2} - 3 \times 8\sqrt{2} + 4 \times 5\sqrt{2}$

$= 2\sqrt{2}+8\sqrt{2}-24\sqrt{2}+20\sqrt{2}$

$= 6\sqrt{2} = 6 \times 1.414 = 8.484.$

**57. (b)** $\sqrt{\sqrt[3]{0.004096}} = \sqrt{((0.16)^3)^{1/3}}$

$= \sqrt{0.16} = 0.4.$

**58. (a)** $\sqrt{\frac{5}{3}} = \sqrt{\frac{5\times3}{3\times3}} = \sqrt{\frac{15}{3}} = \frac{3.88}{3} = 1.29\overline{3}.$

**59. (b)** $\sqrt{5625} + \sqrt{56.25} + \sqrt{0.5625}$

$= \sqrt{5625}+\sqrt{\frac{5625}{100}}+\sqrt{\frac{5625}{1000}} = 75+\frac{75}{10}+\frac{75}{100}$

$= 75 + 7.5 + 0.75 = 83.25.$

**60. (d)** $\frac{36}{6}\times\sqrt{?} = 108$

or, $\sqrt{?} = \frac{108}{6}$

or, $\sqrt{?} = 18$

or, $? = 324 \approx 325.$

**61. (b)** $\sqrt{10000} + \frac{3.001}{4.987}$ of $1891.992 = ?$

or, $? \approx 100 + \frac{3}{5}$ of $1900 = 100 + 1140 \approx 1230.$

**62. (c)** $1.\overline{27} = 1\frac{27}{99} = 1\frac{3}{11} = \frac{14}{11}$

**63. (b)** $2p+\frac{1}{p} = 4$

$\Rightarrow p + \frac{1}{2p} = 2$

Therefore, $\left(p+\frac{1}{2p}\right)^3$

$\Rightarrow p^3 + \frac{1}{8p^3} + 3 \times p \times \frac{1}{2p}\left(1+\frac{1}{2p}\right)$

$\Rightarrow 8 = p^3 + \frac{1}{8p^3}+\frac{3}{2}\times2$

$\Rightarrow p^3 + \frac{1}{8p^3} = 8 - 3 = 5$

**64. (d)** $0.1 \times 0.01 \times 0.001 \times 10^7$

$= 10^{-6} \times 10^7 = 10^1 = 10$

**65. (c)** $[(\sqrt[5]{x^{-3/5}})^{-5/3}]^5 = (x^{-3/5})^{1/5 \times -5/3 \times 5}$

$= x^{-3/5 \times -5/3} = x$

**66. (a)** $\left(1-\frac{1}{3}\right)\left(1-\frac{1}{4}\right)\left(1-\frac{1}{5}\right)\ldots\left(1-\frac{1}{24}\right)\left(1-\frac{1}{25}\right)$

$= \frac{2}{3}\times\frac{3}{4}\times\frac{4}{5}\times\ldots\times\frac{23}{24}\times\frac{24}{25} = \frac{2}{25}$

**67. (b)** $\frac{3\sqrt{2}}{\sqrt{3}+\sqrt{6}}-\frac{4\sqrt{3}}{\sqrt{6}+\sqrt{2}}+\frac{\sqrt{6}}{\sqrt{3}+\sqrt{2}}$

$= \frac{3\sqrt{2}(\sqrt{3}-\sqrt{6})}{(\sqrt{3}+\sqrt{6})(\sqrt{3}-\sqrt{6})} - \frac{4\sqrt{3}(\sqrt{6}-\sqrt{2})}{(\sqrt{6}+\sqrt{2})(\sqrt{6}-\sqrt{2})}$

$+\frac{\sqrt{6}(\sqrt{3}-\sqrt{2})}{(\sqrt{3}+\sqrt{2})(\sqrt{3}-\sqrt{2})}$

$= \frac{3\sqrt{6}-6\sqrt{3}}{(-3)}-\frac{12\sqrt{2}-4\sqrt{6}}{4}+\frac{3\sqrt{2}-2\sqrt{3}}{1}$

$= \frac{-\sqrt{6}+2\sqrt{3}}{1}-\frac{3\sqrt{2}-\sqrt{6}}{1}$

$= -\sqrt{6}+2\sqrt{3}-3\sqrt{2}+\sqrt{6}+3\sqrt{2}-2\sqrt{3} = 0$

**68. (a)** $\dfrac{2\frac{1}{3}-1\frac{2}{11}}{3+\dfrac{1}{3+\dfrac{1}{\frac{9+1}{1}}}} = \dfrac{\frac{7}{3}-\frac{13}{11}}{3+\dfrac{1}{3+\frac{3}{10}}}$

$$= \frac{\frac{77-39}{33}}{3+\frac{1}{\frac{33}{10}}} = \frac{\frac{38}{33}}{3+\frac{10}{33}}$$

$$= \frac{38}{33}\times\frac{33}{109} = \frac{38}{109}$$

**69. (b)** $3+\frac{1}{\sqrt{3}}+\left(\frac{1}{3+\sqrt{3}}-\frac{1}{3-\sqrt{3}}\right)$

$$= 3+\frac{1}{\sqrt{3}}+\left(\frac{3-\sqrt{3}}{3+\sqrt{3}}-\frac{3-\sqrt{3}}{3-\sqrt{3}}\right)$$

$$= 3+\frac{1}{\sqrt{3}}-\frac{\sqrt{3}}{3} = 3+\frac{1}{\sqrt{3}}-\frac{1}{\sqrt{3}}$$

$= 3$

**70. (a)** $\dfrac{x+\frac{2}{3+\frac{4}{\frac{30+7}{6}}}}{} = 10$

$$\Rightarrow \quad x+\frac{2}{3+\frac{4\times 6}{37}} = 10$$

$$\Rightarrow \quad x+\frac{2}{3+\frac{24}{37}} = 10$$

$$\Rightarrow \quad x+\frac{2}{\frac{111+24}{37}} = 10$$

$$\Rightarrow \quad x+\frac{2\times 37}{135} = 10$$

$$\Rightarrow \quad x+\frac{74}{135} = 10$$

$$\Rightarrow \quad 10-\frac{74}{135} = x$$

$$\Rightarrow \quad x = 10-\frac{1350-74}{135}$$

$$\Rightarrow \quad x = \frac{1276}{135}$$

**71. (b)** Expression $= 3+\dfrac{3}{3+\frac{1}{3+\frac{1}{3}}}$

$$= 3+\frac{3}{3+\frac{3}{10}} = 3+\frac{3}{\frac{30+3}{10}}$$

$$= 3+\frac{30}{23} = 3+\frac{10}{11}$$

$$= \frac{33+10}{11} = \frac{43}{11}$$

**72. (c)** $x = \sqrt{\frac{\sqrt{5}+1}{\sqrt{5}-1}\times\frac{\sqrt{5}+1}{\sqrt{5}+1}} = \sqrt{\frac{(\sqrt{5}+1)^2}{5-1}}$

$$\sqrt{\frac{(\sqrt{5}+1)^2}{4}} = \frac{\sqrt{5}+1}{2}$$

Therefore, $5x^2 - 5x - 1$

$$= 5\left(\frac{\sqrt{5}+1}{2}\right)^2-\frac{5(\sqrt{5}+1)}{2}-1$$

$$= 5\left(\frac{5+1+2\sqrt{5}}{4}\right)-\frac{5\sqrt{5}+5}{2}-1$$

$$= 5\left(\frac{3+\sqrt{5}}{2}\right)-\frac{5\sqrt{5}+5}{2}-1$$

$$= \frac{15+5\sqrt{5}-5\sqrt{5}-5-2}{2} = \frac{8}{2} = 4$$

**73. (b)** $\dfrac{\sqrt{3+x}+\sqrt{3-x}}{\sqrt{3+x}-\sqrt{3-x}} = 2$

$$\Rightarrow \quad \frac{(\sqrt{3+x}+\sqrt{3-x})^2}{(3+x-3+x)} = 2$$

$$\Rightarrow \quad \frac{3+x+3-x+2\sqrt{9-x^2}}{2x} = 2$$

$$\Rightarrow \quad 6+2\sqrt{9-x^2} = 4x$$

$$\Rightarrow \quad 2\sqrt{9-x^2} = 4x - 6$$

Squaring both sides

$4(9 - x^2) = 16x^2 + 36 - 48x$

$\Rightarrow$ $36 - 4x^2 = 16x^2 + 36 - 48x$

$\Rightarrow$ $20x^2 = 48x$

$$\Rightarrow \quad x = \frac{48}{20} = \frac{12}{5}$$

**74. (c)** 0.121212 ...

$$= \frac{12}{99} = \frac{4}{33}$$

**75. (b)** $? = 3\frac{3}{4}+4\frac{2}{5}-3\frac{1}{8}$

$$? = \frac{15}{4}+\frac{22}{5}-\frac{25}{8}$$

$$? = \frac{150+176-125}{40}$$

$$? = \frac{201}{40} = 5\frac{1}{40}$$

**76. (d)** $\sqrt{5^2 \times 14 - 6 \times 7 + (4)^?} = 18$

$\Rightarrow 5^2 \times 14 - 6 \times 7 + (4)^? = (18)^2$

$\Rightarrow 25 \times 14 - 42 + (4)^? = 324$

$\Rightarrow 350 - 42 + (4)^? = 324$

$\Rightarrow 308 + (4)^? = 324$

$\Rightarrow (4)^? = 324 - 308$

$\Rightarrow (4)^? = 16$

$\Rightarrow (4)^? = (4)^2$

$\Rightarrow ? = 2$

**77. (c)** ? = 67.99% of 1401 − 13.99% of 1299

$\Rightarrow ? = 1401 \times \frac{68}{100} - 1300 \times \frac{14}{100}$

$\Rightarrow ? = 952.68 - 182$

$\Rightarrow ? = 770.68$

$\Rightarrow ? = 770$ (Approx.)

**78. (d)** $? = \left(\frac{24}{9}\right)^2 \times \frac{399}{39} \div \frac{41}{899}$

$\Rightarrow ? = \left(\frac{24}{9}\right)^2 \times \frac{399}{39} \times \frac{899}{41}$

$\Rightarrow ? = 7.11 \times 10.23 \times 21.92$

$\Rightarrow ? = 159.435 = 1550$ (Approx.)

**79. (b)** $(3 \times 2)^{?+5} = (15 \times 0.40)^4 \div (1080 \div 30)^4 \times (27 \times 8)^4$

$\Rightarrow (3 \times 2)^{?+5} = (6)^4 \div (36)^4 \times (216)^4$

$\Rightarrow (6)^{?+5} = (6)^4 \div (6^2)^4 \times (6^3)^4$

$\Rightarrow (6)^{?+5} = (6)^4 + (6)^8 \times (6)^{12}$

$\Rightarrow (6)^{?+5} = (6)^{-4} \times (6)^{12}$

$\Rightarrow (6)^{?+5} = (6)^8$

$\Rightarrow ? + 5 = 8$

$\Rightarrow ? = 8 - 5 = 3$

**80. (d)** $\frac{(?)^2}{10} + 1\frac{5}{12} = 3\frac{1}{4} + 2\frac{1}{2} - 1\frac{5}{6}$

$\Rightarrow \frac{(?)^2}{10} + \frac{17}{12} = \frac{13}{4} + \frac{5}{2} - \frac{11}{6}$

$\Rightarrow \frac{(?)^2}{10} = \frac{13}{4} + \frac{5}{2} - \frac{11}{6} - \frac{17}{12}$

$\Rightarrow \frac{(?)^2}{10} = \frac{39 + 30 - 22 - 17}{12}$

$\Rightarrow \frac{(?)^2}{10} = \frac{69 - 39}{12}$

$\Rightarrow \frac{(?)^2}{10} = \frac{30}{12}$

$\Rightarrow (?)^2 = \frac{30 \times 20}{12}$

$\Rightarrow (?)^2 = 25$

$\Rightarrow ? = \sqrt{25} = 5$

**81. (c)** $(?)^3 + \sqrt{49} = 92 \times 576 \div 2\sqrt{1296}$

$\Rightarrow (?)^3 + 7 = 92 \times 576 \div 2 \times 36$

$\Rightarrow (?)^3 + 7 = 92 \times 576 \div 72$

$\Rightarrow (?)^3 + 7 = 92 \times 8$

$\Rightarrow (?)^3 + 7 = 736$

$\Rightarrow (?)^3 = 736 - 7 = 729$

$\Rightarrow ? = \sqrt[3]{729}$

$\Rightarrow ? = 9$

**82. (c)** $85 + ? = \frac{1}{6}$ of (92)% of $1\frac{1}{23}$ of 650

$\Rightarrow 85 + ? = \frac{1}{6} \times \frac{92}{100} \times \frac{24}{23} \times 650$

$\Rightarrow 85 + ? = 104$

$\Rightarrow ? = 104 - 85$

$\Rightarrow ? = 19$

**83. (c)** ∵ Price of a pencil box = 7 + 22 + 14 = ₹43

Hence the, required amount Seema paid to the shopkeeper

= 20 × 7 + 8 × 22 + 6 × 175 + 7 × 43

= 140 + 176 + 1050 + 301 = ₹1667.

**84. (b)** $a^2 + b^2 + c^2 = ab + bc + ca$

$\Rightarrow a^2 + b^2 + c^2 - ab - bc - ca = 0$

On multiplying by 2, we have,

$2a^2 + 2b^2 + 2c^2 - 2ab - 2bc - 2ca = 0$

$\Rightarrow a^2 + b^2 - 2ab + b^2 + c^2 - 2bc + c^2 + a^2 - 2ac = 0$

$\Rightarrow (a - b)^2 + (b - c)^2 + (c - a)^2 = 0$

$\Rightarrow a - b = 0$

$\Rightarrow a = b;\ b - c = 0 \Rightarrow b = c$ and $c - a = 0$

$\Rightarrow c = a$

$\therefore \frac{a + c}{b} = \frac{2a}{a} = 2$

**85. (a)** $ab + bc + ca = 0$

$\Rightarrow ab + ca = -bc$

$\therefore a^2 - bc = a^2 + ab + ac = a(a + b + c)$

Similarly,

$b^2 - ac = b(a + b + c)$, and

$c^2 - ab = c(a + b + c)$

$\therefore \frac{1}{a^2 - bc} + \frac{1}{b^2 - ca} + \frac{1}{c^2 - ab}$

$= \frac{1}{a(a+b+c)} + \frac{1}{b(a+b+c)} + \frac{1}{c(a+b+c)}$

$= \frac{1}{(a+b+c)}\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right) = \frac{1}{(a+b+c)}\left(\frac{ac + ca + ab}{abc}\right)$

$= \frac{1}{a+b+c} \times \frac{0}{abc} = 0$

**86.** **(d)** $\left(2+\sqrt{3}\right)a=\left(2-\sqrt{3}\right)b=1$

$\Rightarrow\quad a=\dfrac{1}{2+\sqrt{3}}$

$\therefore\quad \dfrac{1}{a}=2+\sqrt{3}$

Similarly,

$b=\dfrac{1}{2-\sqrt{3}}$

$\dfrac{1}{b}=2-\sqrt{3}$

$\therefore\quad \dfrac{1}{a}+\dfrac{1}{b}=2+\sqrt{3}+2-\sqrt{3}=4$

**87.** **(b)** $3x+\dfrac{3}{x}=1 \quad\Rightarrow\quad x+\dfrac{1}{x}=\dfrac{1}{3}$

On cubing both sides, we have,

$x^3+\dfrac{1}{x^3}+3\left(x+\dfrac{1}{x}\right)=\dfrac{1}{27}$

$\Rightarrow\quad x^3+\dfrac{1}{x^3}+3\times\dfrac{1}{3}=\dfrac{1}{27}$

$\Rightarrow\quad x^3+\dfrac{1}{x^3}+1=\dfrac{1}{27}$

**88.** **(d)** $\dfrac{1}{a^2+ax+x^2}-\dfrac{1}{a^2-ax+x^2}+\dfrac{2ax}{a^4+a^2x^2+x^4}$

$=\dfrac{a^2-ax+x^2-a^2-ax-x^2}{(a^2+ax+x^2)(a^2-ax+x^2)}+\dfrac{2ax}{a^4+a^2x^2+x^4}$

$=\dfrac{-2ax}{a^4+a^2x^2+x^4}+\dfrac{2ax}{a^4+a^2x^2+x^4}=0$

**89.** **(c)** $x^3+y^3+z^3-3xyz=\dfrac{1}{2}(x+y+z)$

$[(x-y)^2+(y-z)^2+(z-x)^2]$

$=\dfrac{1}{2}(333+333+334)(0+1+1)=1000$

**90.** **(a)** Quicker Method:

When $x=(a+b+c)^2$, then

$\dfrac{x-a^2}{b+c}+\dfrac{x-b^2}{c+a}+\dfrac{x-c^2}{a+b}$

$=\dfrac{(a+b+c)^2-a^2}{b+c}+\dfrac{(a+b+c)^2-b^2}{c+a}+\dfrac{(a+b+c)^2-c^2}{a+b}$

$=\dfrac{(2a+b+c)(b+c)}{a+b}+\dfrac{(a+2b+c)(c+a)}{c+a}+\dfrac{(a+b+2c)(a+b)}{a+b}$

$=2a+b+c+a+2b+c+a+b+2c$

$=4a+4b+4c=4(a+b+c)$

**91.** **(d)** $\left(x-a\right)^3-\dfrac{1}{(x-a)^3}$

$=\left(x-a-\dfrac{1}{x-a}\right)^3+3\left(x-a-\dfrac{1}{x-a}\right)$

$=(x-a-x+b)^3+3(x-a-x+b)$

$=(b-a)^3+3(b-a)$

$=5^3+3\times5=125+15=140$

**92.** **(a)** Let, $x=\sqrt{2\sqrt[3]{4\sqrt{2\sqrt[3]{4\ldots}}}}$

On squaring, we have, $x^2=2\sqrt[3]{4\sqrt{2\sqrt[3]{4\ldots}}}$

On cubing, we have, $x^6 = 8\times 4x$

$\Rightarrow\quad x^5=32=2^5 \quad\Rightarrow\quad x=2$

**93.** **(b)** $\dfrac{3\sqrt{2}}{\sqrt{3}+\sqrt{6}}=\dfrac{3\sqrt{2}\left(\sqrt{6}-\sqrt{3}\right)}{\left(\sqrt{6}+\sqrt{3}\right)\left(\sqrt{6}-\sqrt{3}\right)}$

$=\dfrac{3\sqrt{2}\left(\sqrt{6}-\sqrt{3}\right)}{6-3}=\sqrt{2}\left(\sqrt{6}-\sqrt{3}\right)=2\sqrt{3}-\sqrt{6}$

$\dfrac{4\sqrt{3}}{\sqrt{6}+\sqrt{2}}=\dfrac{4\sqrt{3}\left(\sqrt{6}-\sqrt{2}\right)}{\left(\sqrt{6}+\sqrt{2}\right)\left(\sqrt{6}-\sqrt{2}\right)}$

$=\dfrac{4\sqrt{3}\left(\sqrt{6}-\sqrt{2}\right)}{6-2}=\sqrt{3}\left(\sqrt{6}-\sqrt{2}\right)=3\sqrt{2}-\sqrt{6}$

$\dfrac{\sqrt{6}}{\sqrt{3}+\sqrt{2}}=\dfrac{\sqrt{6}\left(\sqrt{3}-\sqrt{2}\right)}{\left(\sqrt{3}+\sqrt{2}\right)\left(\sqrt{3}-\sqrt{2}\right)}=\dfrac{\sqrt{6}\left(\sqrt{3}-\sqrt{2}\right)}{3-2}$

$=\sqrt{6}\left(\sqrt{3}-\sqrt{2}\right)=3\sqrt{2}-2\sqrt{3}$

$\therefore$ The given expression

$=2\sqrt{3}-\sqrt{6}-3\sqrt{2}+\sqrt{6}+3\sqrt{2}-2\sqrt{3}=0$

**94.** **(a)** $a^2+b^2+c^2=2(a-b-c)-3$

$\Rightarrow\quad a^2+b^2+c^2-2a+2b+2c+3=0$

$\Rightarrow\quad a^2-2a+1+b^2+2b+1+c^2+2c+1=0$

$\Rightarrow\quad (a-1)^2+(b+1)^2+(c+1)^2=0$

$\therefore\quad a-1=0 \quad\Rightarrow\quad a=1$

$b+1=0 \quad\Rightarrow\quad b=-1$

$c+1=0 \quad\Rightarrow\quad c=-1$

$\therefore\quad 4a-3b+5c=4\times1-3\times(-1)+5(-1)$

$=4+3-5=2$

**95.** **(c)** $2x+\dfrac{2}{x}=3 \quad\Rightarrow\quad x+\dfrac{1}{x}=\dfrac{3}{2}$

On cubing, we have,

$x^3+\dfrac{1}{x^3}+3\left(x+\dfrac{1}{x}\right)=\dfrac{27}{8}$

$\Rightarrow\quad x^3+\dfrac{1}{x^3}+3\times\dfrac{3}{2}=\dfrac{27}{8}$

$\Rightarrow\quad x^3+\dfrac{1}{x^3}=\dfrac{27}{8}=\dfrac{9}{2}-\dfrac{27-36}{8}=-\dfrac{9}{8}$

$\therefore\quad x^3+\dfrac{1}{x^3}+2=2-\dfrac{9}{8}=\dfrac{7}{8}$

**96. (a)** $a^2 - b^2 + b^2 - c^2 + c^2 - a^2 = 0$

$\therefore \quad (a^2 - b^2)^3 + (b^2 - c^2)^3 + (c^2 - a^2)^3$

$= 3(a^2 - b^2)(b^2 - c^2)(c^2 - a^2)$

[If $x + y + z = 0$, then, $x^3 + y^3 + z^3 = 3xyz$]

$= 3(a+b)(a-b)(b+c)(b-c)(c+a)(c-a)$

**97. (d)** $x = \sqrt[3]{5} + 2 \quad \Rightarrow \quad x - 2 = \sqrt[3]{5}$

On cubing, we have,

$x^3 - 3x^2 \times 2 + 3x(-2)^2 - 2^3 = 5$

$\Rightarrow \quad x^3 - 6x^2 + 12x - 8 = 5$

$\Rightarrow \quad x^3 - 6x^2 + 12x - 13 = 0$

**98. (d)** $\dfrac{1}{3-\sqrt{8}} = \dfrac{3+\sqrt{8}}{(3-\sqrt{8})(3+\sqrt{8})}$

(Rationalizing the denominator)

$= \dfrac{3+\sqrt{8}}{9-8} = +\sqrt{8}$

$\therefore$ The given expression

$= 3 + \sqrt{8} + 3 + \sqrt{8} - 6 - 4\sqrt{2}$

$= 6 + 2\sqrt{8} - 6 - 4\sqrt{2} = 2\sqrt{8} - 4\sqrt{2}$

$= 2 \times 2\sqrt{2} - 4\sqrt{2} = 0$

**99. (c)** $x^2 + \dfrac{1}{x^2} = 83$

$\Rightarrow \quad \left(x - \dfrac{1}{x}\right)^2 + 2 = 83$

$\Rightarrow \quad \left(x - \dfrac{1}{x}\right)^2 = 83 - 2 = 81 = 9^2$

$\Rightarrow \quad x - \dfrac{1}{x} = 9$

Cubing both sides, we have

$\left(x - \dfrac{1}{x}\right)^3 = 9^3 = 729$

$\Rightarrow \quad x^3 - \dfrac{1}{x^3} - 3\left(x - \dfrac{1}{x}\right) = 729$

$\Rightarrow \quad x^3 - \dfrac{1}{x^3} - 3 \times 9 = 729$

$\Rightarrow \quad x^3 - \dfrac{1}{x^3} = 729 + 27 = 756$

**100. (d)** $\left(a + \dfrac{1}{a}\right)^2 = 3 = \left(\sqrt{3}\right)^2$

$\Rightarrow \quad a + \dfrac{1}{a} = \sqrt{3}$

Cubing both sides, we have $\left(a + \dfrac{1}{a}\right)^3 = 3\sqrt{3}$

$\Rightarrow \quad a^3 + \dfrac{1}{a^3} + 3\left(a + \dfrac{1}{a}\right) = 3\sqrt{3}$

$\Rightarrow \quad a^3 + \dfrac{1}{a^3} + 3\sqrt{3} = 3\sqrt{3} \quad \Rightarrow \quad a^3 + \dfrac{1}{a^3} = 0$

**101. (b)** $a = 7 - 4\sqrt{3}$

$\therefore \dfrac{1}{a} = \dfrac{1}{7-4\sqrt{3}} = \dfrac{1}{7-4\sqrt{3}} \times \dfrac{7+4\sqrt{3}}{7+4\sqrt{3}} = 7 + 4\sqrt{3}$

$\therefore \left(\sqrt{a} + \dfrac{1}{\sqrt{a}}\right)^2 = a + \dfrac{1}{a} + 2$

$= 7 - 4\sqrt{3} + 7 + 4\sqrt{3} + 2 = 16$

$\Rightarrow \quad \sqrt{a} + \dfrac{1}{\sqrt{a}} = 4$

**102. (b)** $\dfrac{3\sqrt{2}}{\sqrt{6}-\sqrt{3}} = \dfrac{3\sqrt{2}}{\sqrt{6}-\sqrt{3}} \times \dfrac{\sqrt{6}+\sqrt{3}}{\sqrt{6}+\sqrt{3}}$

$= \dfrac{3\sqrt{2}\left(\sqrt{6}+\sqrt{3}\right)}{6-3}$

$= \sqrt{12} + \sqrt{6} = 2\sqrt{3} + \sqrt{6}$

$\dfrac{4\sqrt{3}}{\sqrt{6}-\sqrt{2}} = \dfrac{4\sqrt{3}\left(\sqrt{6}+\sqrt{2}\right)}{6-2}$

$= \sqrt{18} + \sqrt{6} = 3\sqrt{2} + \sqrt{6}$

$\dfrac{6}{\sqrt{8}+\sqrt{12}} = \dfrac{6\left(\sqrt{12}-\sqrt{8}\right)}{12-8}$

$= \dfrac{3}{2}\left(2\sqrt{3} - 2\sqrt{2}\right) = 3\sqrt{3} - 3\sqrt{2}$

$\therefore$ Given expression

$= 2\sqrt{3} + \sqrt{6} - 3\sqrt{2} - \sqrt{6} - 3\sqrt{3} + 3\sqrt{2} = -\sqrt{3}$

**103. (d)** $x^3 + y^3 + z^3 - 3xyz$

$= (x+y+z)(x^2 + y^2 + z^2 - xy - yz - zx)$

$= (x+y+z)(x+y+z)^2 - 3xy - 3yz - 3zx$

$\Rightarrow x^3 + y^3 + z^3 + 3 = 1[1 - 3(-1)] = 4$

$\Rightarrow x^3 + y^3 + z^3 = 1$

**104. (c)** $x^2 + y^2 + z^2 = xy + yz + zx$

$\Rightarrow \quad 2x^2 + 2y^2 + 2z^2 - 2xy - 2yz - 2zx = 0$

$\Rightarrow \quad (x-y)^2 + (y-z)^2 + (z-x)^2 = 0$

$\Rightarrow \quad x - y = 0 \quad \Rightarrow \quad x = y$

$y - z = 0 \quad \Rightarrow \quad y = z$

$z - x = 0 \quad \Rightarrow \quad z = x$

$\therefore \dfrac{4x + 2y - 3z}{2x} = \dfrac{4 + 2 - 3}{2} = \dfrac{3}{2}$

**105.** **(c)** $3x-2=\frac{3}{x} \Rightarrow 3x-\frac{3}{x}=2$

Dividing both sides by 3, we have

$x-\frac{1}{x}=\frac{2}{3}$

On squaring both sides, we get

$x^2+\frac{1}{x^2}-2=\frac{4}{9}$

$\Rightarrow x^2+\frac{1}{x^2}=\frac{4}{9}+2=\frac{22}{9}=2\frac{4}{9}$

**106.** **(a)** $x^2 + y^2 + z^2 + 2 = 2(y - x)$

$\Rightarrow x^2 + 2x + y^2 - 2y + z^2 + 2 = 0$

$\Rightarrow (x^2 + 2x + 1) + (y^2 - 2y + 1) + z^2 = 0$

$\Rightarrow (x + 1)^2 + (y - 1)^2 + z^2 = 0$

$\Rightarrow x + 1 = 0 \Rightarrow x = -1$

$y - 1 = 0 \Rightarrow y = 1$

$z = 0$

$\therefore x^3 + y^3 + z^3 = -1 + 1 + 0 = 0$

**107.** **(b)** $180 = 2 \times 2 \times 3 \times 3 \times 5$

$a^3b = abc$

$\Rightarrow a^2 = bc$

$a^3b = abc = 180 = 1^2 \times 180 \times 1$

$= 1^3 \times 180$

$\Rightarrow c = 1$

**108.** **(a)** $\left(x+\frac{1}{x}\right)^2=3$

$\Rightarrow x+\frac{1}{x}=\sqrt{3}$

On cubing both sides,

$\left(x+\frac{1}{x}\right)^3=3\sqrt{3}$

$\Rightarrow x^3+\frac{1}{x^3}+3\left(x+\frac{1}{x}\right)=3\sqrt{3}$

$\Rightarrow x^3+\frac{1}{x^3}+3\sqrt{3}=3\sqrt{3}$

$\Rightarrow x^3+\frac{1}{x^3}=0 \Rightarrow x^6+1=0$

$\therefore x^{72} + x^{66} + x^{54} + x^{36} + x^{24} + x^6 + 1$

$= (x^6)^{12} + (x^6)^{11} + (x^6)^9 + (x^6)^6 + (x^6)^4 + x^6 + 1$

$= 1 - 1 - 1 + 1 + 1 + 0 = 1$

**109.** **(c)** $a + b + c = 0$

$\Rightarrow b + c = -a$

On squaring both sides,

$\Rightarrow (b + c)^2 = a^2$

$\Rightarrow b^2 + c^2 + 2bc = a^2$

$\Rightarrow a^2 + b^2 + c^2 + 2bc = 2a^2$

$\Rightarrow a^2 + b^2 + c^2 = 2a^2 - 2bc = 2(a^2 - bc)$

$\therefore \frac{a^2+b^2+c^2}{a^2-bc}=2$

**110.** **(b)** $n=7+4\sqrt{3}=7+2\times 2\times\sqrt{3}$

$=4+3+2\times 2\times\sqrt{3}=(2+\sqrt{3})^2$

$\therefore \sqrt{n}=2+\sqrt{3}$

$\therefore \frac{1}{\sqrt{n}}=\frac{1}{2+\sqrt{3}}=\frac{1}{2+\sqrt{3}}\times\frac{2-\sqrt{3}}{2-\sqrt{3}}=2-\sqrt{3}$

$\therefore \sqrt{n}=\frac{1}{\sqrt{n}}=2+\sqrt{3}+2-\sqrt{3}=4$

**111.** **(b)** $(a + b + c)^2= a^2 + b^2 + c^2 + 2 (ab + bc + ca)$

$\Rightarrow 36 = 14 + 2 (ab + bc + ca)$

$\Rightarrow ab + bc + ca = (36 - 14) \div 2$

$\Rightarrow ab + bc + ca = 11$ ···(1)

$\therefore a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2- ab - bc - ca)$

$\Rightarrow 36 - 3abc = 6(14 - 11)$

$\Rightarrow 36 - 3abc = 84 - 66 = 18$

$\Rightarrow 3abc = 36 - 18 = 18$

$\Rightarrow abc = 6$

**112.** **(d)** $(a-1)\sqrt{2}+3=b\sqrt{2}+a$

$\Rightarrow a = 3;\ a - 1 = b$

$\Rightarrow 3 - 1 = b \Rightarrow b = 2$

$\therefore a + b = 3 + 2 = 5$

**113.** **(a)** $\left(x+\frac{1}{x}\right)^2=3 \Rightarrow x+\frac{1}{x}=\sqrt{3}$

One cubing both sides,

$x^3+\frac{1}{x^3}+3\left(x+\frac{1}{x}\right)=3\sqrt{3}$

$\Rightarrow x^3+\frac{1}{x^3}=3\sqrt{3}-3\sqrt{3}=0$

$\Rightarrow x^6+1=0$

$\therefore x^{206}+x^{200}+x^{90}+x^{84}+x^{18}+x^{12}+x^6+1$

$=x^{200}(x^6+1)+x^{84}(x^6+1)+x^{12}(x^6+1)+(x^6+1)=0$

**114.** **(c)** Given expression $=\frac{(81)^{3.6}\times(9)^{2.7}}{(81)^{4.2}\times 3}$

$=\frac{(3^4)^{3.6}\times(3^2)^{2.7}}{(3^4)^{4.2}\times 3}=\frac{3^{14.4}\times 3^{5.4}}{3^{16.8}\times 3}$

$\left[\because (a^m)^n=a^{nm}; a^m\times a^n=a^{m+n}; a^m\div a^n=a^{m-n}\right]$

$=\frac{3^{14.4+5.4}}{3^{16.8+1}}=\frac{3^{19.8}}{3^{17.8}}$

$=3^{19.8-17.8}=3^2=9$

**115.** **(c)** Let the marked price of article be ₹$x$ and CP be ₹100.

Now, according to the question,

$$\frac{60x}{100}=100-30=70$$

$$\Rightarrow \quad 60x=70\times 100$$

$$\Rightarrow \quad x=\frac{70\times 100}{60}=\frac{700}{6}=₹\frac{350}{3}$$

On selling at marked price, we have

$$\text{profit}=\frac{350}{3}-100=\frac{50}{3}=16\frac{2}{3}$$

$$\therefore \quad \text{profit}\%=16\frac{2}{3}\%$$

**116.** **(c)** $a^2+b^2+c^2=2a-2b-2c-3$

$$\Rightarrow \quad a^2+b^2+c^2-2a+2b+2c+1+1+1=0$$

$$\Rightarrow \quad (a^2-2a+1)+(b^2+2b+1)+(c^2+2c+1)=0$$

$$\Rightarrow \quad (a-1)^2+(b+1)^2+(c+1)^2=0$$

$$\Rightarrow \quad a-1=0 \quad \Rightarrow \quad a=1$$

$$\Rightarrow \quad b+1=0 \quad \Rightarrow \quad b=-1$$

$$\Rightarrow \quad c+1=0 \quad \Rightarrow \quad c=-1$$

$$\therefore \quad a-b+c=1+1-1=1$$

**117.** **(a)** $x^2+3x+1=0$

On dividing by $x$, we have

$$x+3+\frac{1}{x}=0 \qquad \Rightarrow \quad x+\frac{1}{x}=-3$$

Cubing both sides,

$$\left(x+\frac{1}{x}\right)^3=x^3+\frac{1}{x^3}+3\left(x+\frac{1}{x}\right)$$

$$\Rightarrow \quad (-3)^3=x^3+\frac{1}{x^3}+3(-3)$$

$$\Rightarrow \quad -27=x^3+\frac{1}{x^3}-9$$

$$\Rightarrow \quad x^3+\frac{1}{x^3}=-27+9=-18$$

**118.** **(d)** $x^a.x^b.x^c=1 \qquad \Rightarrow \quad x^{a+b+c}=1=x^0$

$\Rightarrow \quad a+b+c=0$

Now, $a^3+b^3+c^3-3abc=(a+b+c)(a^2+b^2+c^3-ab-bc-ca)$

$\Rightarrow \quad a^3+b^3+c^3-3abc=0$

$\Rightarrow \quad a^3+b^3+c^3=3abc$

**119.** **(b)** $a+\frac{1}{a}+2=0$

$$a^2+1+2a=0$$

$$\Rightarrow \quad (a+1)^2=0 \Rightarrow a+1=0$$

$$\Rightarrow \quad a=-1$$

$$\therefore \quad a^{37}-\frac{1}{a^{100}}=(-1)^{37}-\frac{1}{(-1)^{100}}$$

$$=-1-1=-2$$

**120.** **(b)** $x+\frac{1}{16x}=1 \qquad \Rightarrow \quad 4x+\frac{1}{4x}=4$

On cubing both sides, we have

$$\left(4x+\frac{1}{4x}\right)^3$$

$$=(4x)^3+\left(\frac{1}{4x}\right)^3+3\times 4x\times\frac{1}{4x}\left(4x+\frac{1}{4x}\right)$$

$$\Rightarrow \quad 64=64x^3+\frac{1}{64x^3}+3\times 4$$

$$\Rightarrow \quad 64x^3+\frac{1}{64x^3}=64-12=52$$

**121.** **(b)** $a+b+c=0$

$$\Rightarrow \quad (a+c)=-b$$

On squaring both sides, we have

$$a^2+c^2+2ac=b^2$$

$$\Rightarrow \quad a^2+c^2=b^2-2ac$$

$$\therefore \quad \frac{a^2+b^2+c^2}{b^2-ca}=\frac{b^2+b^2-2ac}{b^2-ca}=\frac{2(b^2-ac)}{b^2-ac}=2$$

**122.** **(d)** $a^4+a^2b^2+b^4=(a^2+ab+b^2)(a^2-ab+b^2)$

$$\Rightarrow \quad 8=4(a^2-ab+b^2)$$

$$\Rightarrow \quad a^2-ab+b^2=2 \qquad \cdots(1)$$

$$a^2+ab+b^2=4 \qquad \cdots(2)$$

By equation (2) – (1)

$$a^2+ab+b^2-a^2+ab-b^2=4-2$$

$$\Rightarrow \quad 2ab=2 \Rightarrow ab=1$$

**123.** **(d)** $a^3+b^3+c^3-3abc=(a+b+c)(a^2+b^2+c^2-ab-bc-ca)$

$$=\frac{1}{2}(a+b+c)[(a-b)^2+(b-c)+(c-a)^2]$$

$\therefore$ Given expression

$$=\frac{\frac{1}{2}(a+b+c)[(a-b)^2+(b-c)^2+(c-a)^2]}{(a-b)^2+(b-c)^2+(c-a)^2}$$

$$=\frac{1}{2}(a+b+c)=\frac{1}{2}(25+15-10)=15$$

**124** **(a)** $x^{1/3}+y^{1/3}=z^{1/3} \qquad \cdots(1)$

$\Rightarrow \quad (x^{1/3}+y^{1/3})^3=z$

$\Rightarrow \quad x+y+3x^{1/3}y^{1/3}\,(x^{1/3}+y^{1/3})=z$

$\Rightarrow \quad x+y+3x^{1/3}y^{1/3}z^{1/3}=z$

[Using equation (1)]

$\Rightarrow \quad x+y-z=-\,3x^{1/3}y^{1/3}z^{1/3}$

$\Rightarrow \quad (x+y-z)^3=-27xyz$

$\Rightarrow \quad (x+y-z)^3+27xyz=0$

**125.** **(c)** $\sqrt{7\sqrt{7\sqrt{7\ldots}}} = 7^{\frac{1}{2}+\frac{1}{4}+\frac{1}{8}\cdots}$

$= 7^{\frac{1/2}{1-1/2}} = 7^{\frac{1/2}{1/2}} = 7$

Now, $7 = (343)^{y-1} = (7^3)^{y-1}$

$\Rightarrow \; 7^1 = 7^{3y-3} \;\; \Rightarrow \;\; 3y - 3 = 1$

$\Rightarrow \; 3y = 4 \quad \therefore \; y = \dfrac{4}{3}$

**126.** **(c)** $a + b + c = 1$

Putting $a = b = c = \dfrac{1}{3}$

$$\therefore \; a+b+c = \frac{1}{3}+\frac{1}{3}+\frac{1}{3} = 1 \qquad \cdots(1)$$

and, $ab+bc+ca = \dfrac{1}{3}\times\dfrac{1}{3}+\dfrac{1}{3}\times\dfrac{1}{3}+\dfrac{1}{3}\times\dfrac{1}{3} = \dfrac{3}{9}$

$$\Rightarrow ab+bc+ca = \frac{1}{3} \qquad \cdots(2)$$

On satisfying both the conditions,

$a = b = c = \dfrac{1}{3}$

$\therefore \; a:b:c = 1:1:1$

**127.** **(c)** $\because a^2+b^2+\dfrac{1}{a^2}+\dfrac{1}{b^2} = 4$

$\Rightarrow \left(a^2-2+\dfrac{1}{a^2}\right)+\left(b^2-2+\dfrac{1}{b^2}\right) = 0$

$\Rightarrow \left(a-\dfrac{1}{a}\right)^2+\left(b-\dfrac{1}{b}\right)^2 = 0$

$\because$ Square quantities are always positive.

$\therefore \left(a-\dfrac{1}{a}\right) = 0 \Rightarrow a^2 = 1$ and, $\left(b-\dfrac{1}{b}\right) = 0.$

$\Rightarrow \; b^2 = 1$

$\therefore \; a^2 + b^2 = 1 + 1 = 2$

**128.** **(d)** $\therefore \left(x+\dfrac{1}{x}\right)^2 = 3$

$\Rightarrow x+\dfrac{1}{x} = \sqrt{3}$

$\Rightarrow \left(x+\dfrac{1}{x}\right)^3 = (\sqrt{3})^3$

$\Rightarrow x^3+\dfrac{1}{x^3}+3\left(x+\dfrac{1}{x}\right) = 3\sqrt{3}$

$\Rightarrow x^3+\dfrac{1}{x^3}+3(\sqrt{3}) = 3\sqrt{3}$

$\therefore \; x^3+\dfrac{1}{x^3} = 3\sqrt{3}-3\sqrt{3} = 0$

**129.** **(a)** Let $x = 0.1$ and $y = 0.02$

Now, given expression $= \dfrac{x^3+y^3}{(2x)^3+(2y)^3}$

$= \dfrac{x^3+y^3}{8x^3+8y^3} = \dfrac{1}{8} = 0.125$

**130.** **(a)** $x+\dfrac{1}{x} = 2$

The equation satisfies when we put $x = 1$

Let, $x^{100}+\dfrac{1}{x^{100}} = k$ (for all values of $x$)

Then, it will be same for $x = 1$

$k = x^{100}+\dfrac{1}{x^{100}} = 1^{100}+\dfrac{1}{1^{100}} = 1+1 = 2$

**131.** **(c)** $\therefore \; x^3 + 3x^2 + 3x = 7$

$\Rightarrow \; x^3 + 3x^2 + 3x + 1 = 8$

$\Rightarrow \; (x+1)^3 = (2)^3$

$\Rightarrow \; x + 1 = 2$

$\therefore \; x = 1$

**132.** **(b)** $\because 2x+\dfrac{2}{x} = 1$

$\Rightarrow x+\dfrac{1}{x} = \dfrac{1}{2}$

$\Rightarrow \left(x+\dfrac{1}{x}\right)^3 = \left(\dfrac{1}{2}\right)^3$

$\Rightarrow x^3+\dfrac{1}{x^3}+3\left(x+\dfrac{1}{x}\right) = \dfrac{1}{8}$

$\therefore \; x^3+\dfrac{1}{x^3} = \dfrac{1}{8}-\dfrac{3}{2} = -\dfrac{11}{8}$

**133.** **(a)** $\therefore \sqrt{16+6\sqrt{7}} = \sqrt{9+7+2\sqrt{9\times 7}}$

$= \sqrt{(\sqrt{9}+\sqrt{7})^2} = \sqrt{9}+\sqrt{7}$

Similarly, $\sqrt{16-6\sqrt{7}} = \sqrt{9}-\sqrt{7}$

$\therefore \sqrt{16+6\sqrt{7}}-\sqrt{16-6\sqrt{7}}$

$= \sqrt{9}+\sqrt{7}-\sqrt{9}+\sqrt{7}$

$= 2\sqrt{7}$

$\therefore$ Given expression $= \dfrac{\sqrt{7}}{2\sqrt{7}} = \dfrac{1}{2}$

**134.** **(c)** $2x+\dfrac{1}{3x} = 6 \;\; \Rightarrow \dfrac{6x^2+1}{3x} = 6$

$\Rightarrow \dfrac{6x^2+1}{3x}\times\dfrac{3}{2} = 6\times\dfrac{3}{2}$

$\Rightarrow \dfrac{6x^2+1}{2x} = 9$

$\therefore \; 3x+\dfrac{1}{2x} = 9$

**135. (a)** $\because \quad x = (\sqrt{2}-1)^{-1/2}$

$\therefore \quad x^2 = (\sqrt{2}-1)^{-1} = \frac{1}{\sqrt{2}-1}$

$\Rightarrow \quad \frac{1}{x^2} = \frac{1}{(\sqrt{2}-1)^{-1}} = \sqrt{2}-1$

$\therefore \quad x^2 - \frac{1}{x^2} = \frac{1}{\sqrt{2}-1} - (\sqrt{2}-1)$

$= \frac{1}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1} - (\sqrt{2}-1)$

$= \sqrt{2}+1-\sqrt{2}+1 = 2$

**136. (b)** Given expression $= \frac{3}{4} \times \frac{4}{3} \times \frac{5}{3} \times \frac{3}{5} \times \frac{13}{7} \times \frac{1}{13} = \frac{1}{7}$

**137. (c)** Let 0.87 = $a$ and 0.13 = $b$

We have, $\frac{a^3+b^3}{a^2+b^2-ab} = a+b$

$[\because a^3+b^3 = (a+b)(a^2+b^2-ab)]$

$\therefore$ Given expression = 0.87 + 0.13 = 1

**138. (d)** $\therefore \quad x^2 + y^2 - 2x + 6y + 10 = 0$

$\Rightarrow \quad x^2 - 2x + 1 + y^2 + 6y + 9 = 0$

$\Rightarrow \quad (x-1)^2 + (y+3)^2 = 0$

The value of both $(x-1)^2$ and $(y+3)^2$ aresquare numbers.

They cannot be negativeand since when two numbers are positive,on adding we cannot get zero.

$\therefore$ Both have to be zero

$\Rightarrow \quad (x-1)^2 = 0$

$\Rightarrow \quad x = 1$

$\Rightarrow \quad (y+3)^2 = 0$

$\Rightarrow \quad y = -3$

$\therefore \quad x^2 + y^2 = 10$

**139. (a)** ? = 21 + 3.9 × 2.9 + 8.99 ≈ 21 + 4 × 3
= 21 + 12 + 9 = 42

**140. (b)** 22.9889 ÷ ? = 23

or, $\frac{23}{?} = 23$ or, $? = \frac{23}{23} = 1$

**141. (b)** $10^? + 10^? = 10^3 \times 100^3 + 999999999$

$= 10^3 \times 10^6 + 1000000000$

$= 10^9 + 10^9$

or, $2 \times 10^? = 2 \times 10^9$

$\therefore \quad ? = 9$

**142. (d)** ? × 116 = 4003 × 77 − 21015

or, ? × 116 = 308231 − 21015 = 287216

or, ? × 116 = 287216

$\therefore \quad ? = \frac{287216}{116} = 2476$

**143. (b)** $? = (4444 \div 40) + (645 \div 25) + (3991 \div 26)$

$= \frac{4440}{40} + \frac{645}{25} + \frac{3991}{26}$

$= 111.1 + 25.8 + 153.5 = 290.4$

**144. (b)** $? = 5\frac{17}{37} \times 4\frac{51}{52} \times 11\frac{1}{7} + 2\frac{3}{4}$

$= \frac{202}{37} \times \frac{259}{52} \times \frac{78}{7} + \frac{11}{4} = \frac{202}{37} \times \frac{259}{7} \times \frac{3}{2} + \frac{11}{4}$

$= 101 \times 3 + \frac{11}{4} = 303 + \frac{11}{4} = \frac{1212+11}{4}$

$= \frac{1223}{4} = 305.75$

**145. (c)** $? = \frac{5}{8} \times 4011.33 + \frac{7}{10} \times 3411.22$

$= \frac{20056.65}{8} + \frac{23878.54}{10}$

$= 2507.08 + 2387.854 = 2507 + 2387 = 4894 \approx 4890$

**146. (a)** $? = 335.01 \times 244.99 \div 55$

$= 335 \times 245 \div 55$

$= 335 \times \frac{245}{55} = \frac{82075}{55} = 1422.27 \approx 1490$

**147. (a)** 3463 × 295 −18611 = ? + 5883

$\Rightarrow$ ? = 1021585 − 18611 − 5883 = 997091

**148. (c)** 533.61 + 2361.96 − 1584.04 = ? + 1147.69

or, ? = 1311.53 − 1147.69 = 163.84

**149. (d)** $\frac{28}{65} \times \frac{195}{308} \times \frac{44}{39} + \frac{5}{26} = \frac{4}{13} \times \frac{5}{26} = \frac{8+5}{26} = \frac{13}{26} = \frac{1}{2}$

**150. (a)** 43931 ÷ 2111 × 401 = ?

or, ? = 44000 ÷ 2000 × 400

or, $? = \frac{44000}{2000} \times 400 = 8800$

**151. (c)** 60 ÷ 12 × 6 = 30

**152. (b)** $\frac{1}{8} \times \frac{2}{3} \times \frac{3}{5} \times 1715 = 85.75 \approx 85$

**153. (c)** $25 \times 124 + 389 \times 15 = 3100 + 5835 = 8935$

**154. (a)** $\frac{561}{35} \times 20 = 320.5 \approx 320$

**155. (d)** $441 - \frac{3717}{59} = ? \times 8$

$\Rightarrow \frac{441-63}{8} = ?$

$\therefore \quad ? = 47.25$

**156. (d)** $? = 2\frac{1}{8} - 1\frac{1}{16} - 1\frac{1}{32} + 1\frac{9}{64}$

$= 2 - 1 - 1 + 1 + \frac{1}{8} - \frac{1}{16} - \frac{1}{32} + \frac{9}{64}$

$= 1 + \frac{8-4-2+9}{64} = 1 + \frac{11}{64} = 1\frac{11}{64}$

**157. (c)** $[(0.8)^2]^4.[(0.8)^3]^3 \times (0.8) = (0.8)^{?+3}(0.8)^{8-9+4} = (0.8)^{?+3}$

$3 = ? + 3$

$\therefore \quad ? = 0$

**158. (e)** $? = \sqrt{225 \times \frac{12}{9} - 125 + 21} = \sqrt{300 - 125 + 21} = \sqrt{196} = 14$

**159. (b)** $\frac{7441}{34} \times 12 - 110 = ? \times 9$

$\Rightarrow \frac{2626.23 - 110}{9} = ?$

$? = 279.5 \approx 280$

**160. (c)** $? = \frac{989}{34} \times \frac{869}{65} \times \frac{515}{207} = 967.52 \approx 970$

**161. (e)** $? = (32)^2 + (24)^2 - (17)^2$

$\Rightarrow ? = 1024 + 576 - 289$

$\Rightarrow ? = 1311 \approx 1310$

**162. (c)** $? = (292 + 60 - 345) \times 31$

$= (352 - 345) \times 31$

$= 7 \times 31$

$= 217$

**163. (b)** $? = (3 + 4 - 3) + \left(\frac{3}{4} + \frac{2}{5} - \frac{1}{8}\right)$

$= 4 + \frac{30 + 16 - 5}{8 \times 5} = 4 + \frac{41}{40} = 5\frac{1}{40}$

**164. (a)** $\frac{343 \times 49}{216 \times 16 \times 81} = \frac{7^3 \times 7^2}{6^3 \times (4 \times 9)^2} = \frac{7^5}{6^3 \times 6^4} = \frac{7^5}{6^7}$

# Percentage

# 5

## INTRODUCTION

The term *percent* means per hundred or for every hundred. It is the abbreviation of the Latin phrase *percentum*.

Scoring 60 per cent marks means out of every 100 marks the candidate scored 60 marks.

The term percent is sometimes abbreviated as p.c. The symbol % is often used for the term percent.

Thus, 40 percent will be written as 40%.

A fraction whose denominator is 100 is called a *percentage* and the numerator of the fraction is called *rate percent*, e.g., $\frac{5}{100}$ and 5 percent means the same thing, i.e., 5 parts out of every hundred parts.

## SOME BASIC FORMULAE

1. To convert a fraction into a percent:

To convert any fraction $\frac{l}{m}$ to rate percent, multiply it by 100 and put % sign, i.e., $\frac{l}{m} \times 100\%$

**Illustration 1:** What percentage is equivalent to $\frac{3}{5}$?

**Solution:** $\frac{3}{5} \times 100 = 60\%$.

2. To convert a per cent into a fraction:

To convert a percent into a fraction, drop the percent sign and divide the number by 100.

**Illustration 2:** What fraction is $16\frac{2}{3}\%$?

**Solution:** $16\frac{2}{3}\% = \dfrac{\left(\frac{50}{3}\right)}{100} = \left(\frac{50}{3} \times \frac{1}{100}\right) = \frac{1}{6}$.

3. To find a percentage of a given number:

$x\%$ of given number (N) $= \frac{x}{100} \times N$.

**Illustration 3:** 75% of 400 = ?

**Solution:** 75% of 400 $= \frac{75}{100} \times 400 = 300$.

**Illustration 4:** Find a number whose 4% is 72.

**Solution:** Let the required number be $x$.

Then, 4% of $x = 72$

$\Rightarrow \frac{4}{100} \times x = 72 \Rightarrow x = \frac{100}{4} \times 72 = 1800$.

**Illustration 5:** What per cent of 25 Kg is 3.5 Kg?

**Solution:** Let $x\%$ of 25 Kg be 3.5 Kg.

Then, $x\%$ of 25 Kg = 3.5 Kg

$\Rightarrow \frac{x}{100} \times 25 = 3{\cdot}5 \Rightarrow x = \frac{3{\cdot}5 \times 100}{25} = 14$.

Hence, 3.5 Kg is 14% of 25 Kg.

## SOME USEFUL SHORTCUT METHODS

1. (a) If $A$ is $x\%$ more than that of $B$, then $B$ is less than that of $A$ by

$$\left[\frac{x}{100+x} \times 100\right]\%$$

(b) If $A$ is $x\%$ less than that of $B$, then $B$ is more than that of $A$ by

$$\left[\frac{x}{100-x} \times 100\right]\%$$

**Explanation**

Given: $A = B + \frac{x}{100}B = \frac{100+x}{100}B$

$\therefore \quad A - B = \frac{100+x}{100}B - B$

$= \left(\frac{100+x}{100} - 1\right)B = \frac{x}{100}B.$

So, $\frac{A-B}{A} = \frac{\frac{x}{100}B}{\frac{100+x}{100}B} = \frac{x}{100+x}$

$\Rightarrow \quad A - B = \left(\frac{x}{100+x} \times 100\right)\%$ of $A$.

Therefore, $B$ is less than that of $A$ by

$$\left(\frac{x}{100+x} \times 100\right)\%$$

Similarly, (b) can be proved.

**Illustration 6:** If Mohan's salary is 10% more than that of Sohan, then how much per cent is Sohan's salary less than that of Mohan?

**Solution:** Here, $x = 10$.

$\therefore$ Required answer $= \left(\frac{x}{100+x} \times 100\right)\%$

$= \left(\frac{x}{100+x} \times 100\right)\%$

$= 11\frac{1}{9}\%$

**Illustration 7:** If $A$'s income is 40% less than $B$'s income, then how much per cent is $B$'s income more than $A$'s income?

**Solution:** Here, $x = 40$.

$\therefore$ Required answer $= \left(\frac{x}{100-x} \times 100\right)\%$

$= \left(\frac{40}{100-40} \times 100\right)\%$

$= 66\frac{2}{3}\%$

> 2. If $A$ is $x$% of $C$ and $B$ is $y$% of $C$, then
>
> $$A = \frac{x}{y} \times 100\% \text{ of } B.$$

**Explanation**

Given: $A = \frac{x}{100}C \Rightarrow C = 100\frac{A}{x}$

and, $B = \frac{y}{100}C \Rightarrow C = 100\frac{B}{y}$

$\therefore \quad C = 100\frac{A}{x} = 100\frac{B}{y} \Rightarrow A = \frac{x}{y}B$

or, $\frac{x}{y} \times 100\%$ of $B$.

**Illustration 8:** If $A$ is 20% of $C$ and $B$ is 25% of $C$, then what percentage is $A$ of $B$?

**Solution:** Here, $x = 20$ and $y = 25$.

$A = \frac{x}{y} \times 100\%$ of $B$

$= \frac{20}{25} \times 100\%$ of $B$, i.e., 80% of $B$.

> 3. (a) If two numbers are respectively $x$% and $y$% more than a third number, then the first number is $\left(\frac{100+x}{100+y} \times 100\right)$% of the second and the second number is $\left(\frac{100+y}{100+x} \times 100\right)$ % of the first.
>
> (b) If two numbers are, respectively, $x$% and $y$% less than a third number, then the first number is $\left(\frac{100-x}{100-y} \times 100\right)$% of the second and the second number is $\left(\frac{100-y}{100-x} \times 100\right)$ % of the first number.

**Explanation**

Let $A$, $B$ and $C$ be the three numbers.

Given:

$A = C + \frac{x}{100}C = \left(\frac{100+x}{100}\right)C \Rightarrow C = A\left(\frac{100}{100+x}\right)$

and, $B = C + \frac{y}{100}C = \left(\frac{100+y}{100}\right)C \Rightarrow C = B\left(\frac{100}{100+y}\right)$

$\therefore \quad A\left(\frac{100}{100+x}\right) = B\left(\frac{100}{100+y}\right)$

$\Rightarrow \quad A = \left(\frac{100+x}{100+y}\right)B$ or $\left(\frac{100+x}{100+y}\right) \times 100\%$ of $B$

and, $B = \left(\dfrac{100+y}{100+x}\right)A$ or $\left(\dfrac{100+y}{100+x}\right) \times 100\%$ of $A$.

Similarly, (b) can be proved.

**Illustration 9:** Two numbers are respectively 20% and 50% more than a third number. What per cent is the first of the second?

**Solution:** Here, $x = 20$ and $y = 50$.

$$\therefore \quad \text{First number} = \left(\frac{100+x}{100+y}\right) \times 100\% \text{ of the second}$$

$$= \left(\frac{100+20}{100+50}\right) \times 100\% \text{ of the second}$$

i.e., 80% of the second.

**Illustration 10:** Two numbers are, respectively, 32% and 20% less than a third number. What per cent is the first of the second?

**Solution:** Here, $x = 32$ and $y = 20$.

$$\therefore \quad \text{First number} = \left(\frac{100-x}{100-y} \times 100\right)\% \text{ of the second}$$

$$= \left(\frac{100-32}{100-20} \times 100\right)\% \text{ of the second}$$

i.e., 85% of the second.

> 4. (a) If the price of a commodity increases by $P\%$, then the reduction in consumption so as not to increase the expenditure is
>
> $$\left(\frac{P}{100+P} \times 100\right)\%$$
>
> (b) If the price of a commodity decreases by $P\%$, then the increase in consumption so as not to decrease the expenditure is
>
> $$\left(\frac{P}{100-P} \times 100\right)\%$$

**Explanation**

Let the original price of the commodity be ₹100.

Then, the increased price $= 100 + \dfrac{P}{100} \times 100$

$= ₹(100 + P)$.

Therefore, to keep the price unchanged, there should be a reduction in the consumption of the commodity by ₹$P$.

$\because$ Decrease in ₹$(100 + P)$ = ₹$P$

$\therefore$ Decrease in ₹100 $= \dfrac{P}{100+P} \times 100$

$\therefore$ Required reduction in consumption is

$$\left(\frac{P}{100+P} \times 100\right)\%$$

Similarly, (b) part can be proved.

**Illustration 11:** If the price of sugar increases by 25%, find how much per cent its consumption be reduced so as not to increase the expenditure.

**Solution:** Reduction in consumption

$$= \left(\frac{P}{100+P} \times 100\right)\%$$

$$= \left(\frac{25}{100+25} \times 100\right)\% \text{ or } 20\%$$

**Illustration 12:** If the price of a commodity decreases by 25%, find how much per cent its consumption be increased so as not to decrease the expenditure.

**Solution:** Increase in consumption

$$= \left(\frac{P}{100-P} \times 100\right)\%$$

$$= \left(\frac{25}{100-25} \times 100\right)\% \text{ or } 33\frac{1}{3}\%$$

> 5. If a number is changed (increased/decreased) successively by $x\%$ and $y\%$, then net % change is given by $\left(x + y + \dfrac{xy}{100}\right)\%$ which represents increase or decrease in value according as the sign is +ve or –ve.
>
> If $x$ or $y$ indicates decrease in percentage, then put –ve sign before $x$ or $y$, otherwise +ve sign.

**Explanation**

Let the given number be $N$.

If it is increased by $x\%$, then it becomes

$$N + x\% \text{ of } N = N + \frac{Nx}{100} = \frac{N(x+100)}{100}.$$

If it is further increased by $y\%$, then it becomes

$$\frac{N(x+100)}{100} + \frac{y}{100} \times \frac{N(x+100)}{100}$$

$$= \frac{N(x+100)\,(y+100)}{(100)^2}$$

$$\therefore \quad \text{Net change} = \frac{N(x+100)\,(y+100)}{(100)^2} - N$$

$$= \frac{N(100x+100y+xy)}{(100)^2}$$

$\therefore$ % change $= N\left(x+y+\dfrac{xy}{100}\right)\times\dfrac{1}{100}\times\dfrac{100}{N}$

$$= \left(x+y+\frac{xy}{100}\right)\%$$

**Illustration 13:** If salary of a person is first increased by 15% and thereafter decreased by 12%, what is the net change in his salary?

**Solution:** Here, $x$ = 15 and $y$ = –12.

$\therefore$ The net% change in the salary

$$= \left(x+y+\frac{xy}{100}\right)\% = \left(15-12-\frac{15\times12}{100}\right)\% \text{ or } 1.2\%$$

Since the sign is +ve, the salary of the person increases by 1.2%

**Illustration 14:** The population of a town is decreased by 25% and 40% in two successive years. What per cent population is decreased after two years?

**Solution:** Here, $x$ = – 25 and $y$ = – 40.

$\therefore$ The net% change in population

$$= \left(x+y+\frac{xy}{100}\right)\%$$

$$= \left(-25-40+\frac{25\times40}{100}\right)\% \text{ or } -55\%$$

Since the sign is –ve, there is decrease in population after two years by 55%

6. If two parameters $A$ and $B$ are multiplied to get a product and if $A$ is changed (increased/decreased) by $x$% and another parameter $B$ is changed (increased/decreased) by $y$%, then the net % change in the product ($A \times B$) is given $\left(x+y+\dfrac{xy}{100}\right)$% which represents increase or decrease in value according as the sign in +ve or –ve.

If $x$ or $y$ indicates decrease in percentage, then put –ve sign before $x$ or $y$, otherwise +ve sign.

**Illustration 15:** If the side of a square is increased by 20%, its area is increased by $k$%. Find the value of $k$.

**Solution:** Since side × side = area

$\therefore$ Net% change in area

$$= \left(x+y+\frac{xy}{100}\right)\% = \left(20+20+\frac{20\times20}{100}\right)\%$$

[Here, $x$ = 20 and $y$ = 20]

= 44%

Therefore, the area is increased by 44%.

Here, $k$ = 44.

**Illustration 16:** The radius of a circle is increased by 2%. Find the percentage increase in its area.

**Solution:** Since $\pi$ × radius × radius = area

$\therefore$ Net% change in area

$$= \left(x+y+\frac{xy}{100}\right)\% = \left(2+2+\frac{2\times2}{100}\right)\%$$

[Here, $x$ = 2 and $y$ = 2]

$$= 4\frac{1}{25}\%$$

Therefore, the percentage increase in area is $4\dfrac{1}{25}$%

**Illustration 17:** The tax on a commodity is diminished by 15% and its consumption increases by 10%. Find the effect on revenue.

**Solution:** Since tax × consumption = revenue

$\therefore$ Net% change in revenue

$$= \left(x+y+\frac{xy}{100}\right)\% = \left(-15+10-\frac{15\times10}{100}\right)\%$$

[Here, $x$ = – 15 and $y$ = 10]

= – 6.5%

$\therefore$ The revenue decreases by 6.5%

7. If the present population of a town (or value of an item) be $P$ and the population (or value of item) changes at $r$% per annum, then

   (a) Population (or value of item) after $n$ years

   $$= P\left(1+\frac{r}{100}\right)^n$$

   (b) Population (or value of item) $n$ years ago

   $$= \frac{P}{\left(1+\dfrac{r}{100}\right)^n}.$$

   where $r$ is +ve or –ve according as the population (or value of item) increases or decreases.

**Explanation**

Population at the end of first year

$$= P + \frac{r}{100}P = P\left(1+\frac{r}{100}\right).$$

Now, the population at the beginning of second year

$$= P\left(1+\frac{r}{100}\right).$$

$\therefore$ Population at the end of second year

$$= P\left(1+\frac{r}{100}\right)+\frac{r}{100}P\left(1+\frac{r}{100}\right) = P\left(1+\frac{r}{100}\right)^2$$

$\vdots \qquad \vdots \qquad \vdots$

Population at the end of $n$ years $= P\left(1+\frac{r}{100}\right)^n$.

**Illustration 18:** The population of a town increases 5% annually. If its present population is 84000, what will it be in 2 years time?

**Solution:** Here, $P$ = 84000, $r$ = 5 and $n$ = 2.

$\therefore$ Population of the town after 2 years

$$= P\left(1+\frac{r}{100}\right)^n = 84000\left(1+\frac{5}{100}\right)^2$$

$$= 84000 \times \frac{105}{100}\times\frac{105}{100} = 92610.$$

**Illustration 19:** The population of a town increases at the rate of 5% annually. If the present population is 4410, what it was 2 years ago?

**Solution:** Here, $P$ = 4410, $r$ = 5 and $n$ = 2.

$\therefore$ Population of the town 2 years ago

$$= \frac{P}{\left(1+\frac{r}{100}\right)^n} = \frac{4410}{\left(1+\frac{5}{100}\right)^2} = \frac{4410}{\frac{105}{100}\times\frac{105}{100}} = 4000.$$

> 8. If a number $A$ is increased successively by $x$% followed by $y$% and then by $z$%, then the final value of $A$ will be
>
> $$A\left(1+\frac{x}{100}\right)\left(1+\frac{y}{100}\right)\left(1+\frac{z}{100}\right)$$
>
> In case a given value decreases by any percentage, we will use a –ve sign before that.

**Illustration 20:** The population of a town is 144000. It increases by 5% during the first year. During the second year, it decreases by 10% and increases by 15% during the third year. What is the population after 3 years?

**Solution:** Here, $P$ = 144000, $x$ = 5, $y$ = – 10 and $z$ = 15.

$\therefore$ Population of the town after 3 years

$$= A\left(1+\frac{x}{100}\right)\left(1+\frac{y}{100}\right)\left(1+\frac{z}{100}\right)$$

$$= 144000\left(1+\frac{5}{100}\right)\left(1-\frac{10}{100}\right)\left(1+\frac{15}{100}\right)$$

$$= \frac{144000\times105\times90\times115}{100\times100\times100} = 156492.$$

> 9. In an examination, the minimum pass percentage is $x$% If a student secures $y$ marks and fails by $z$ marks, then the maximum marks in the examination is $\frac{100(y+z)}{x}$.

**Explanation**

Let the maximum marks be $m$.

Given: $x$% of $m = y + z$

$$\Rightarrow \frac{x}{100} \times m = y + z \text{ or } m = \frac{100(y+z)}{x}.$$

**Illustration 21:** In an examination, a student must get 60% marks to pass. If a student who gets 120 marks, fails by 60 marks, find the maximum marks.

**Solution:** Here, $x$ = 60, $y$ = 120 and $z$ = 60.

$\therefore$ Maximum marks

$$= \frac{100(y+z)}{x} = \frac{100(120+60)}{60} = \frac{100\times180}{60} = 300.$$

> 10. In an examination $x$% and $y$% students respectively fail in two different subjects while $z$% students fail in both the subjects, then the percentage of students who pass in both the subjects will be $(100 - (x + y - z))$%

**Explanation**

Percentage of students who failed in one subject = $(x - z)$%

Percentage of students who failed in other subject = $(y - z)$%

Percentage of students who failed in both the subjects = $z$%

$\therefore$ Percentage of students who passed in both the subjects

$= [100 - [(x - z) + (y - z) + z]]$%

$= (100 - (x + y - z))$%

**Illustration 22:** In an examination, 42% students failed in Mathematics and 52% failed in Science. If 17% failed in both the subjects, find the percentage of those who passed in both the subjects.

**Solution:** Here, $x$ = 42, $y$ = 52 and $z$ = 17.

$\therefore$ Percentage of students passing both the subjects

$= (100 - (x + y - z))$%

$= (100 - (42 + 52 - 17))$% or 23%

## Exercise-I

1. What percentage is equivalent to $5\frac{1}{4}$?
   (a) 525% (b) 425%
   (c) 625% (d) None of these
2. $0 \cdot 005 = (\ldots ? \ldots)\%$
   (a) $\frac{1}{4}$ (b) $\frac{1}{2}\%$
   (c) $\frac{1}{3}\%$ (d) None of these
3. $6\frac{2}{3}\%$ expressed as a fraction in its lowest term is:
   (a) $\frac{2}{15}$ (b) $\frac{1}{15}$
   (c) $\frac{3}{20}$ (d) None of these
4. What fraction is 0.6%
   (a) $\frac{7}{500}$ (b) $\frac{9}{500}$
   (c) $\frac{3}{500}$ (d) None of these
5. $0 \cdot 025$ in terms of rate per cent is:
   (a) 3.5% (b) 2.5%
   (c) 1.5% (d) None of these
6. What per cent of 12 is 84?
   (a) 800% (b) 600%
   (c) 700% (d) None of these
7. Express $\frac{7}{8}$ as percentage.
   (a) $67\frac{1}{2}$ (b) $87\frac{1}{2}\%$
   (c) $97\frac{1}{4}\%$ (d) None of these
8. Express $8\frac{1}{3}\%$ as a fraction.
   (a) $\frac{1}{12}$ (b) $\frac{1}{16}$
   (c) $\frac{1}{18}$ (d) None of these
9. $37\frac{1}{2}\%$ of ₹48 is:
   (a) ₹20 (b) ₹16
   (c) ₹18 (d) None of these
10. What per cent of $\frac{2}{7}$ is $\frac{1}{35}$?
    (a) 15% (b) 18%
    (c) 10% (d) None of these
11. 75% of 480 = (?) × 15
    (a) 12 (b) 36
    (c) 24 (d) None of these
12. If 200% of a number is 90, then what is the 80% of that number?
    (a) 48
    (b) 36
    (c) 24
    (d) None of these
13. If $37\frac{1}{2}\%$ of a number is 45, then $87\frac{1}{2}\%$ of the number will be:
    (a) 115 (b) 135
    (c) 105 (d) None of these
14. ? × 15 = 37·5% of 220.
    (a) 5.5 (b) 7.5
    (c) 6.5 (d) None of these
15. What per cent of 4 Km is 8 metres?
    (a) 0.4 (b) 0.2
    (c) 0.8 (d) None of these
16. $x\%$ of $y$ + $y\%$ of $x$ = ?
    (a) 3% of $xy$
    (b) 2% of $xy$
    (c) 5% of $xy$
    (d) None of these
17. 0·35% of a number is equivalent to multiplying it by the number:
    (a) 0.0025 (b) 0.0045
    (c) 0.0035 (d) None of these
18. If 8% of $x$ = 4% of $y$, then 20% of $x$ is:
    (a) 15% of $y$ (b) 10% of $y$
    (c) 20% of $y$ (d) None of these

**19.** $x\%$ of $y$ + ?% of $x$ = $x\%$ of $(x + y)$.

(a) $x + y$ (b) $x$
(c) $y$ (d) None of these

**20.** A number $x$ is 125% of $y$. To compute $y$, the number $x$ has to be multiplied by:

(a) 0.08 (b) 0.4
(c) 0.8 (d) None of these

**21.** 25% of 25% = ?

(a) 6.25 (b) 0.0625
(c) 0.625 (d) None of these

**22.** Which number is 60% less than 80?

(a) 24 (b) 36
(c) 32 (d) None of these

**23.** 20% of 30% of 20% of ₹850 is:

(a) ₹9.50 (b) ₹10.20
(c) ₹10.50 (d) None of these

**24.** The greatest of $16\frac{2}{3}\%$, $6\frac{2}{3}\%$, 0·3 is:

(a) $16\frac{2}{3}\%$ (b) $6\frac{2}{3}\%$
(c) 0.3 (d) Cannot be compared

**25.** 40% of 20% + 30% of 25% + 50% of 28% is equivalent to:

(a) 29.5% (b) 28.5%
(c) 30.5% (d) None of these

**26.** If 90% of $A$ = 30% of $B$ and $B$ = $x\%$ of $A$, then the value of $x$ is:

(a) 800 (b) 300
(c) 700 (d) None of these

**27.** 1 quintal 25 Kg is what per cent of 1 metric tonne?

(a) $16\frac{1}{2}\%$ (b) $8\frac{1}{2}\%$
(c) $12\frac{1}{2}\%$ (d) None of these

**28.** If 12% of $x$ is equal to 6% of $y$, then 18% of $x$ will be equal to how much per cent of $y$?

(a) 7% (b) 9%
(c) 11% (d) None of these

**29.** If a number is 20% more than the other, how much per cent is the second number less than the first?

(a) $12\frac{1}{3}\%$ (b) $16\frac{2}{3}\%$
(c) $16\frac{1}{3}\%$ (d) None of these

**30.** If A's income is 25% less than that of B, then how much per cent is B's income more than that of A?

(a) $33\frac{1}{3}\%$ (b) $66\frac{2}{3}\%$
(c) $11\frac{2}{3}\%$ (d) None of these

**31.** If the given two numbers are respectively 7% and 28% of a third number, then what percentage is the first of the second?

(a) 20% (b) 25%
(c) 18% (d) None of these

**32.** Two numbers are respectively 60% and 20% more than a third number. Second number expressed as a percentage of first is:

(a) 75% (b) 90%
(c) 80% (d) None of these

**33.** Two numbers are less than a third number by 30% and 37%, respectively. How much per cent is the second number less than the first?

(a) 15%
(b) 10%
(c) 20%
(d) None of these

**34.** Two numbers are respectively 20% and 10% more than a third number. How much per cent is the first number more than the second?

(a) $9\frac{1}{11}\%$ (b) $7\frac{1}{11}\%$
(c) $11\frac{1}{11}\%$ (d) None of these

**35.** The price of cooking oil has increased by 15%. The percentage of reduction that a family should effect in the use of cooking oil so as not to increase the expenditure on this account is:

(a) $15\frac{2}{23}\%$ (b) $13\frac{1}{23}\%$
(c) $17\frac{1}{23}\%$ (d) None of these

**36.** If the price of apples goes down by 10%, find the percentage of increase that a family should effect in its consumption so as not to increase expenditure on this account is:

(a) $13\frac{1}{9}\%$ (b) $15\frac{1}{9}$
(c) $11\frac{1}{9}\%$ (d) None of these

**37.** A number is increased by 20% and then decreased by 20%, the final value of the number:

(a) Does not change
(b) Decreases by 2%
(c) Increases by 4%
(d) Decreases by 4%.

**38.** A man's wages were decreased by 50%. Again, the reduced wages were increased by 50%. He has a loss of:

(a) 35% (b) 25%
(c) 20% (d) None of these

**39.** The population of a town is decreased by 20% and 25% in two successive years. What per cent population is decreased after two years?

(a) 50% (b) 40%
(c) 60% None of these

**40.** The difference between a discount of 35% and two successive discounts of 20% and 20% on a certain bill was ₹22. Find the amount of the bill.

(a) ₹3200 (b) ₹2200
(c) ₹1800 (d) None of these

**41.** A shopkeeper marks the prices of his goods at 25% higher than the original price. After that, he allows a discount of 12%. What profit or loss did he make?

(a) 10% profit (b) 15% profit
(c) 10% loss (d) 15% loss

**42.** Two shopkeepers sell a ratio of similar brand and type at the same list price of ₹1000. The first allows two successive discounts of 20% and 10% and the second allows the successive discounts of 15% and 15%. Find the difference in discounts offered by the two shopkeepers.

(a) ₹3.50 (b) ₹1.50
(c) ₹2.50 (d) None of these

**43.** The tax on a commodity is diminished by 10% and its consumption increases by 10%. Find the effects on revenue.

(a) 1% (b) 2%
(c) 3% (d) None of these

**44.** The radius of a sphere is increased by 10%. The surface area increases by

(a) 21% (b) 31%
(c) 41% (d) None of these

**45.** When the price of an article is reduced by 15%, the sales increases by 35%. The percentage change in the total amount of receipts is:

(a) $14\frac{3}{4}$% decrease (b) $14\frac{3}{4}$% increase
(c) $13\frac{3}{4}$% decrease (d) None of these

**46.** If the side of a square is increased by 30%, its area is increased by:

(a) 49% (b) 69%
(c) 79% (d) None of these

**47.** The length and breadth of a square are increased by 30% and 20%, respectively. The area of the rectangle so formed exceeds the area of the square by:

(a) 56% (b) 46%
(c) 66% (d) None of these

**48.** In measuring the sides of a rectangle, one side is taken 10% in excess and the other 20% in deficit. Find the error per cent in area calculated from the measurement.

(a) 12% deficit (b) 10% deficit
(c) 12% excess (d) None of these

**49.** For a rectangle, the length and breadth are increased by 10% and 20%, respectively. The percentage increase in area is:

(a) 24% (b) 48%
(c) 32% (d) None of these

**50.** Water tax is increased by 20% but its consumption is decreased by 20%. The increase or decrease in the expenditure is:

(a) 4% decrease
(b) 4% increase
(c) 8% decrease
(d) 8% increase

**51.** On decreasing the price of a colour TV by 30%, its sale is increased by 20%. The effect on the revenue is:

(a) 16% decrease (b) 16% increase
(c) 20% increase (d) None of these

**52.** The population of a city increases at the rate of 10% annually. Its present population is 90.51 lacs. The population 3 years ago was nearly:

(a) 72 Lakhs (b) 68 Lakhs
(c) 80 Lakhs (d) None of these

**53.** The value of a machine depreciates at the rate of 10% every year. It was purchased 3 years ago. If its present value is ₹8748, its purchase price was:

(a) ₹16000 (b) ₹18000
(c) ₹12000 (d) None of these

**54.** The income of a company increases 20% per annum. If its income is ₹2664000 in the year 1999 what was its income in the year 1997?

(a) ₹1750000 (b) ₹1650000
(c) ₹1850000 (d) None of these

**55.** The population of a town is 32000. It increases 15% annually. What will it be in 2 years?

(a) 52340 (b) 42320
(c) 62430 (d) None of these

**56.** The value of a machine is ₹6250. It decreases by 10% during the first year, 20% during the second year and 30% during the third year. What will be the value of the machine after 3 years?

(a) ₹2650 (b) ₹3050
(c) ₹3150 (d) None of these

**57.** The population of a town increases by 12% during first year and decreases by 10% during second year. If the present population is 50400, what it was 2 years ago?

(a) 40000 (b) 35000
(c) 50000 (d) None of these

**58.** Ramesh loses 20% of his pocket money. After spending 25% of the remainder he has ₹480 left. What was his pocket money?

(a) ₹600 (b) ₹800
(c) ₹900 (d) None of these

**59.** An army lost 10% its men in war, 10% of the remaining due to diseases and 10% of the rest were hurt. Thus, the strength was reduced to 729000 active men. Find the original strength.

(a) 1000000 (b) 1200000
(c) 1500000 (d) None of these

**60.** The daily wage is increased by 25% and a person now gets ₹25 per day. What was his daily wage before the increase?

(a) ₹25 (b) ₹20
(c) ₹30 (d) None of these

**61.** A student has to secure 15% marks to get through. If he gets 80 marks and fails by 70 marks, find the maximum marks set for the examination.

(a) 900 (b) 1000
(c) 1200 (d) None of these

**62.** In an examination, 30% and 35% students respectively failed in History and Geography while 27% students failed in both the subjects. If the number of students passing the examination is 248, find the total number of students who appeared in the examination.

(a) 425 (b) 380
(c) 400 (d) None of these

**63.** Mr Katial buys a house for ₹100000 and rents it. He puts 12.5% of each month's rent aside for upkeep and repairs, pays ₹325 per year as taxes and realizes 5.5% annually on his investment. Find the monthly rent.

(a) ₹634.76 (b) ₹554.76
(c) ₹654.76 (d) None of these

**64.** In an examination, there were 2000 candidates, out of which 900 candidates were boys and rest were girls. If 32% of the boys and 38% of the girls passed, then the total percentage of failed candidates is:

(a) 35.3% (b) 64.7%
(c) 68.5% (d) 70%

**65.** From the salary of an officer, 10% is deducted as house rent, 15% of the rest he spends on children's education and 10% of the balance, he spends on clothes. After this expenditure he is left with ₹1377. His salary is:

(a) ₹2000 (b) ₹2040
(c) ₹2100 (d) ₹2200

**66.** If the price of gold increases by 30%, find by how much the quantity of ornaments must be reduced so that the expenditure may remain the same as before?

(a) $27\frac{2}{13}\%$ (b) $23\frac{1}{13}\%$
(c) 30% (d) 19%

**67.** The price of sugar has fallen by 10%. How many quintals can be bought for the same money which was sufficient to buy 18 quintals at the higher price?

(a) 20 (b) 22
(c) 25 (d) 30

**68.** In an examination, there are 1000 boys and 800 girls, 60% of boys and 40% girls passed. The percentage of candidates that failed is:

(a) 48.88 (b) 45.88
(c) 50.00 (d) 49.88

**69.** The price of an article is cut by 20%. To restore it to its original price, the new price must be increased by:

(a) 20% (b) $22\frac{1}{2}\%$
(c) 25% (d) 40%

**70.** In a fraction, numerator is increased by 25% and the denominator is diminished by 10%. The new fraction obtained is $\frac{5}{9}$. The original fraction is:

(a) $\frac{2}{5}$ (b) $\frac{5}{9}$

(c) $\frac{3}{5}$ (d) None of these

**71.** One side of a square is increased by 30%. To maintain the same area the other side will have to be decreased by:

(a) $23\frac{1}{13}\%$ (b) $76\frac{12}{13}\%$

(c) 30% (d) 15%

## Exercise-2
## (Based on Memory)

**1.** On a test consisting of 75 questions carrying one mark each, Samir answered 75% of the first 40 questions correctly. What approximate per cent of the other 35 questions does he need to answer correctly to score 80% on the entire test?

(a) 90 (b) 75

(c) 86 (d) 60

(e) 58

**[NABARD PO, 2008]**

**2.** If the numerator of a fraction is increased by 200% and the denominator of the fraction is increased by 150%, the resultant fractions $\frac{9}{10}$. What is the original fraction:

(a) $\frac{5}{12}$ (b) $\frac{4}{7}$

(c) $\frac{3}{4}$ (d) $\frac{7}{11}$

(e) None of these

**[NABARD PO, 2008]**

**3.** Mohan distributed his total assets to his wife, three sons, two daughters and five grandchildren in such a way that each grandchild got one-eighth of each son or one-tenth of each daughter, his wife got 40 per cent of the total share of his sons and daughters together. If each daughter received asses of worth ₹1.25 Lakh, what was the total worth of the assets received, by his wife and the three grand-children together?

(a) ₹325000 (b) ₹257500

(c) ₹282500 (d) Cannot be determined

(e) None of these

**[SBI PO, 2005]**

**4.** If the numerator of a fraction is increased by 140%, and the denominator is increased by 150%, the resultant fraction is $\frac{4}{15}$. What is the original fraction

(a) $\frac{3}{5}$ (b) $\frac{5}{16}$

(c) $\frac{4}{18}$ (d) $\frac{3}{10}$

(e) None of these

**[Maharashtra (Specialist Officer), 2008]**

**5.** On a test consisting 150 questions carrying 1 mark each, Meenal answered 80% of the first 75 questions correctly. What per cent of the other 75 questions does she need to answer correctly to score 60% on the entire exam?

(a) 60 (b) 20

(c) 50 (d) 40

(e) None of these

**[Maharashtra (Specialist Officer), 2008]**

**6.** (43% of 2750) – (38% of 2990) = ?

(a) 49.3 (b) 44.7

(c) 43.6 (d) 46.3

(e) None of these

**[Bank of Baroda PO, 2007]**

**7.** Ms Sujata invests 7% i.e., ₹2170, of her monthly salary in mutual fund. Later she invests 18% of her monthly salary in recurring deposits. Also, she invests 6% of her salary on NSC's. What is the total annual amount invested by Ms Sujata?

(a) ₹1,25,320 (b) ₹1,25,320

(c) ₹1,35,120 (d) ₹1,15,320

(e) None of these

**[Bank of Baroda PO, 2007]**

**8.** If the numerator of a fraction is increased by 250% and the denominator by 400%, the resultant fraction is $\frac{7}{19}$. What is the original fraction?

(a) $\frac{10}{19}$ (b) $\frac{5}{9}$
(c) $\frac{9}{5}$ (d) $\frac{19}{7}$
(e) None of these

**[Bank of Baroda PO, 2007]**

**9.** In a class of 65 students, each student got sweets that are 20% of the total number of students. How many sweets were there.

(a) 635 (b) 845
(c) 955 (d) Cannot be determined
(e) None of these

**[IDBI Bank, 2007]**

**10.** If the numerator of a fraction is increased by 200% and the denominatoris increased by 300%, the resultant fraction is $\frac{6}{11}$. What is the original fraction?

(a) $\frac{8}{11}$ (b) $\frac{5}{13}$
(c) $\frac{6}{17}$ (d) $\frac{17}{9}$
(e) None of these

**[IDBI Bank, 2007]**

**11.** Keshav spent ₹55,475 on his birthday party, ₹28, 525 on buying home appliances and the remainning 25% of the total amount he had as cash with him. What was the total amount?

(a) ₹1,05,000 (b) ₹1,00,000
(c) ₹1,12,000 (d) ₹1,24,000
(e) None of these

**[Corporation Bank PO, 2007]**

**12.** Mr Sinha invests 12% of his mothly salary, i.e., ₹3,660 in Insurance Policies. Later he invests 16% of his monthly salary on Family Mediclaim Policies; also he invest another 3% of his salary on NSCs. What is the total annual amount invested by Mr Sinha?

(a) ₹1,13,460
(b) ₹1,22,440
(c) ₹1,06,540
(d) Cannot be determined
(e) None of these

**[Corporation Bank PO, 2007]**

**13.** 75% of a number is 380 more than 35 of the same number. What is 20% of that number?

(a) 190 (b) 195.5
(c) 189.5 (d) 180
(e) None of these

**[Allahabad Bank SO, 2007]**

**14.** The production of wheat across the country in the year 2003 was 5600 tons. In the same year if 700 tons of wheat was produced in the state of Haryana, what percentage did it contribution to the total production of wheat across the country?

(a) 13% (b) 12.5%
(c) 13.5% (d) 14%
(e) None of these

**[Allahabad Bank SO, 2007]**

**15.** In a class of 90 students, amongst 50% of the students each student got a a number of sweets that are 20% of the total number of students and amongst the remaining 50% of the students each student got a number of sweets that are 10% of the total number of students. How many sweets were distributed among the 90 students?

(a) 1620 (b) 1215
(c) 960 (d) Cannot be determined
(e) None of these

**[Allahabad Bank SO, 2007]**

**16.** Mrs Sharma invests 15% of her monthly salary, i.e., ₹4,428 in Mutual funds. Late she invests 18% of her monthly salary on Pension Policies; also, she invests another 9% of her salary of Insurance Policies. What is the total monthly amount invested by Mrs Sharma?

(a) ₹1,13,356.80 (b) ₹12,398.40
(c) ₹56,678.40 (d) Cannot be determined
(e) None of these

**[Allahabad Bank SO, 2007]**

**17.** Two numbers are less than the third number by 50% and 54% respectively. By how much per cent is the second number less than the first number?

(a) 13 (b) 10
(c) 12 (d) Cannot be determined
(e) None of these

**[Bank of Maharashtra PO, 2008]**

**18.** In an election between two candidates, one got 52% of the total valid votes were invalid. 25% of the total votes were invalid. The total number of votes was 8400. How many valid votes did the other person get?

(a) 3276 (b) 3196
(c) 3024 (d) Cannot be determined
(e) 58

**[Bank of Maharashtra PO, 2008]**

**19.** A sum of ₹731 is divided among A, B and C, such that 'A' receives 25% more than 'B' and 'B' receives 25% less than 'C'. What is C's share in the amount?

(a) ₹172 (b) ₹200
(c) ₹262 (d) ₹258
(e) None of these

**[Andhra Bank PO, 2006]**

**20.** If the numerator of a fraction is increased by 150% and the denominator of the fraction is increased by 300%, the resultant fraction is $\frac{5}{18}$. What is the original fraction?

(a) $\frac{4}{9}$ (b) $\frac{4}{5}$
(c) $\frac{8}{9}$ (d) $\frac{8}{11}$
(e) None of these

**[Andhra Bank PO, 2006]**

**21.** What is 25% of 30% of $\frac{2}{5}$ of 2000?

(a) 36 (b) 40
(c) 56 (d) 60
(e) None of these

**[Andhra Bank PO, 2006]**

**22.** Vipul decided to donate 5% of his salary. On the day of donation he changed his mind and donated ₹1687.50, which was 75% of what he had decided earlier. How much is Vipul's salary?

(a) ₹37,500 (b) ₹45,000
(c) ₹33,750 (d) Cannot be determined
(e) None of these

**[Corporation Bank PO, 2006]**

**23.** The difference between 40% of a number and 28% of the same number is 198. Waht is 64% of that number?

(a) 1122 (b) 1065
(c) 1056 (d) 1023
(e) None of these

**[LIC ADO, 2007]**

**24.** If 50% of $(x - y)$ = 30% of $(x + y)$, then what per cent of $x$ is $y$?

(a) 25% (b) 33%
(c) 40% (d) 400%

**[SSC (GL) Prel. Examination, 2005]**

**25.** Given that 10% of A's income = 15% of B's income = 20% of C's income. If sum of their incomes is ₹7800, then B's income is:

(a) ₹3600 (b) ₹3000
(c) ₹2400 (d) ₹1800

**[SSC (GL) Prel. Examination, 2005]**

**26.** If a number $x$ is 10% less than another number $y$ and $y$ is 10% more than 125, then $x$ is equal to:

(a) 150 (b) 143
(c) 140.55 (d) 123.75

**[SSC (GL) Prel. Examination, 2005]**

**27.** Salary of a person is first increased by 20% and then it is decreased by 20%. Change in his salary is:

(a) 4% decreased
(b) 4% inceased
(c) 8% decreased
(d) Neither decreased nor increased

**[SSC (GL) Prel. Examination, 2005]**

**28.** A reduction of $33\frac{1}{3}$% in the price of an item would enable a purchase to get 4 more for a rupee. The price before reduction was:

(a) 12 per rupee (b) 4 per rupee
(c) 12 per rupee (d) 8 per rupee
(e) None of these

**[SSC (GL) Prel. Examination, 2005]**

**29.** The income of a company increases 20% per annum. If its income is ₹2664000 in the year 1999, what was its income in the year 1997?

(a) ₹2220000 (b) ₹2850000
(c) ₹2121000 (d) ₹1855000
(e) None of these

**[BSRB Patna PO, 2001]**

**30.** Mr X, a businessman, had income in the year 1995 such that he earned a profit of 20% on his investment in the business. In the year 1996 his investment was less by ₹5000 but still had the same income (Income = Investment + Profit) as that in 1995. Thus the per cent profit earned in 1996 increased by 26%. What was his investment in 1995?

(a) ₹100000 (b) ₹100500
(c) ₹105000 (d) Data inadequate
(e) None of these

**[SBI PO, 2001]**

**31.** The production of a company has ups and downs every year. The production increase for two consecutive years consistently by 15% and in the third year it decrease by 10%. Again, in the next two years it increases by 15% each years and decreases by 10% in the third year. If we start counting from the year 1990 approximately what will be the effect on the production of the company in 1994?

(a) 37% increase (b) 42% increase
(c) 52% increase (d) 32% increase
(e) 27% increase

**[Corporation Bank PO, 2002]**

**32.** 125% of 260 + ? % of 700 = 500
(a) 32 (b) 56
(c) 25 (d) 46
(e) None of these

**[Andhra Bank SO, 2002]**

**33.** 45% of 750 – 25% of 480 =
(a) 216 (b) 217.50
(c) 245 (d) 236·50
(e) None of these

**[Andhra Bank SO, 2001]**

**34.** If 40% of a number is equal to two-thirds of another number, what is the ratio of the first number to the second?
(a) 7:3 (b) 3:7
(c) 2:5 (d) 5:3
(e) None of these

**[Andhra Bank SO, 2001]**

**35.** A shopkeeper earns a profit of 15% after selling a book at 20% discount on the printed price. The ratio of the cost price and the printed price of the book is:
(a) 20:23 (b) 23:20
(c) 16:23 (d) 23:16
(e) None of these

**[SSC (GL) Prel. Examination, 2002]**

**36.** Successive discounts of 20% and 15% are equivalent to a single discount of:
(a) 68% (b) 65%
(c) 35% (d) 32%

**[SSC (GL) Prel. Examination, 2002]**

**37.** The market price of a watch is ₹800. A shopkeeper gives two successive discounts and sells the watch for ₹612. If the first discount is 10%, then the second discount is:
(a) 12% (b) 20%
(c) 15% (d) 10%

**[SSC (GL) Prel. Examination, 2002]**

**38.** 5% of 5% of ₹100 is:
(a) ₹0.25 (b) ₹0.50
(c) ₹10 (d) ₹25

**[SSC (GL) Prel. Examination, 2002]**

**39.** If 20% of an electricity bill is deducted, then ₹100 are still to be paid. How much was the original bill?
(a) ₹110 (b) ₹115
(c) ₹120 (d) ₹125

**[SSC (GL) Prel. Examination, 2002]**

**40.** If $x$% of $y$ is 100 and $y$% of $z$ is 200, then find a relation between $x$ and $z$.
(a) $z = \frac{x}{2}$ (b) $z = 2x$
(c) $x = \frac{z}{4}$ (d) $z = 4x$

**[SSC (GL) Prel. Examination, 2002]**

**41.** 40% of the greater number is equal to 60% of the smaller. If their sum is 150, then the greater number is:
(a) 70 (b) 80
(c) 90 (d) 60

**[SSC (GL) Prel. Examination, 2002]**

**42.** Two numbers are less than a third number by 30% and 37% respectively. How much per cent is the second number less than the first?
(a) 7% (b) 10%
(c) 4% (d) 3%

**[SSC (GL) Prel. Examination, 2002]**

**43.** 8% of the voters in an election did not cast their votes. In this election, there were only two candidates. The winner by obtaining 48% of the total votes defeated his rival by 1100 votes. The total number of voters in the election was:
(a) 2100 (b) 23500
(c) 22000 (d) 27500

**[SSC (GL) Prel. Examination, 2003]**

**44.** The present population of a city is 180000. If it increases at the rate of 10% per annum, its population after 2 years will be:
(a) 207800 (b) 227800
(c) 217800 (d) 237800

**[SSC (GL) Prel. Examination, 2003]**

**45.** A reduction of 20% in the price of salt enabled a purchaser to obtain 4 Kg more for ₹100. The reduced price of salt per Kg is:
(a) ₹4 (b) ₹5
(c) ₹6.25 (d) ₹6.50

**[SSC (GL) Prel. Examination, 2003]**

**46.** If 60% of A's income is equal to 75% of B's income, then B's income is equal to $x$% of A's income. The value of $x$ is:
(a) 70 (b) 60
(c) 80 (d) 90

**[SSC (GL) Prel. Examination, 2003]**

**47.** A discount of 14% on the marked price of an article is allowed and then the article is sold for ₹387. The marked price of the article is:

(a) ₹450 (b) ₹427
(c) ₹500 (d) ₹440

**[SSC (GL) Prel. Examination, 2003]**

**48.** A trader marked the selling price of an article at 10% above the cost price. At the time of selling he allows certain discount and suffers a loss of 1%. He allowed a discount of

(a) 11% (b) 10%
(c) 9% (d) 10.5%

**[SSC (GL) Prel. Examination, 2003]**

**49.** By giving a discount of 10% on the marked price of ₹1100 of a cycle, a dealer gains 10%. The cost price of the cycle is:

(a) ₹1100 (b) ₹900
(c) ₹1089 (d) ₹891

**[SSC (GL) Prel. Examination, 2003]**

**50.** A trader marks his goods at 20% above the cost price. If he allows a discount of 5% on the marked price, what profit per cent does he make?

(a) 14% (b) 16%
(c) 18% (d) 20%

**[SSC (GL) Prel. Examination, 2003]**

**51.** A person gave 20% of his income to his elder son, 30% of the remaining to the younger son and 10% of the balance he denoted to a trust. He is left with ₹10080. His income was:

(a) ₹50000 (b) ₹40000
(c) ₹30000 (d) ₹20000

**[SSC (GL) Prel. Examination, 2003]**

**52.** In an examination there were 640 boys and 360 girls. 60% of boys and 80% of girls were successful. The percentage of failure was:

(a) 20 (b) 60
(c) 30.5 (d) 32.8

**[SSC (GL) Prel. Examination, 2003]**

**53.** A number is increased by 10% and then decreased by 10%. Finally the number:

(a) Does not change (b) Decreases by 1%
(c) Increases by 1% (d) Increases by 0.1%

**[SSC (GL) Prel. Examination, 2003]**

**54.** A reduction of 20% in the price of rice enables a person to buy 3·5 Kg more rice for ₹385. The original price of rice per Kg is:

(a) ₹20 (b) ₹22.50
(c) ₹25 (d) ₹27.50

**[SSC (GL) Prel. Examination, 2003]**

**55.** Difference of two numbers is 1660. If $6\frac{1}{2}\%$ of one number is $8\frac{1}{2}\%$ of the other number, the smaller number is:

(a) 7055 (b) 5395
(c) 3735 (d) 2075

**[SSC (GL) Prel. Examination, 2003]**

**56.** The price of an article is raised by 30% and then two successive discounts of 10% each are allowed. Ultimately the price of the article is:

(a) Increased by 10%
(b) Increased by 5.3%
(c) Decreased by 3%
(d) Decreased by 5.3%

**[SSC (GL) Prel. Examination, 2003]**

**57.** A tradesman gives 4% discount on the marked price and gives 1 article free for buying every 15 articles and thus gains 35%. The marked price is increased above the cost price by:

(a) 40% (b) 39%
(c) 50% (d) 20%

**[SSC (GL) Prel. Examination, 2003]**

**58.** Radha spends 40% of her salary on food, 20% on houre rent, 10% on entertainment and 10% on conveyance. If her savings at the end of a month are ₹1500, then her salary per month (in ₹) is:

(a) 8000 (b) 7500
(c) 6000 (d) 10000

**[SSC (GL) Prel. Examination, 2003]**

**59.** In a class of 35 students and 6 teachers, each student got sweets that are 20% of the total number of students and eachteacher got sweet that are 40% of the total number of students. How many sweets were there?

(a) 245 (b) 161
(c) 406 (d) 84
(e) None of these

**[Oriental Bank of Commerce PO Examination, 2009]**

**60.** If 1 micron = 10,000 angstroms, then 100 angstroms is what per cent of 10 microns?

(a) 0.0001% (b) 0.001%
(c) 0.01% (d) 0.1%

**[REC Tiruchirapalli, 2003]**

**61.** A man walked diagonally across a square lot. Approx., what was the per cent saved by not walking along the edges?

(a) 30 (b) 20
(c) 33 (d) 24

**62.** The normal dosage of a particular medicine is $t$ tablets per day for each patient. A hospital's current supply of these tablets will last $p$ patients for $d$ days. If the recommended dosage increases by 20% and the number of patients decreases by one-third, then for how many days will the hospital's supply last?

(a) $\frac{5d}{4}$ (b) $\frac{4d}{5}$
(c) $\frac{4pt}{5}$ (d) None of these

**63.** A clothing supplier stores 800 coats in a warehouse, of which 15% are full-length-coats. If 500 of the shorter length coats are removed from the warehouse, then what per cent of the remaining coats are full-length?

(a) 5.62% (b) 34%
(c) 40% (d) 48%

**64.** If $S$ is 150% of $T$, then $T$ is what per cent of $S + T$ ?

(a) $33\frac{1}{3}\%$ (b) 40%
(c) 75% (d) 80%

**65.** At a school, 20% of the students are seniors. If all of the seniors attended the school play, and 60% of all the students attended the play, then what per cent of the non-seniors attended the play?

(a) 20% (b) 40%
(c) 50% (d) 100%

**66.** The price of an article was first increased by 10% and then again by 20%. If the last increased price be ₹33, the original price was:

(a) ₹30 (b) ₹27.50
(c) ₹26.50 (d) ₹25

**[SSC (GL), 2010]**

**67.** If an electricity bill is paid before due date, one gets a reduction of 4% on the amount of the bill. By paying the bill before due date a person got a reduction of ₹13. The amount of his electricity bill was:

(a) ₹125 (b) ₹225
(c) ₹325 (d) ₹425

**[SSC (GL), 2010]**

**68.** In a recent survey 40% houses contained two or more people. Of those houses containing only one person 25% were having only a male. What is the percentage of all houses which contain exactly one female and no males?

(a) 75 (b) 40
(c) 15 (d) None of these

**[SBI PO Examination, 2000]**

**69.** When the price of sugar decreases by 10%, a man could buy 1 Kg more for ₹270. Then the original price of sugar per Kg is:

(a) ₹25 (b) ₹30
(c) ₹27 (d) ₹32

**[SSC (GL), 2011]**

**70.** First and second numbers are less than a third number by 30% and 37%, respectively. The second number is less than the first by:

(a) 7% (b) 4%
(c) 3% (d) 10%

**[SSC (GL), 2011]**

**71.** If the height of a triangle is decreased by 40% and its base is increased by 40%, what will be the effect on its area?

(a) No change (b) 16% increase
(c) 8% decrease (d) 16% decrease

**[SBI PO, 1999]**

**72.** In 1 Kg mixture of sand and iron, 20% is iron. How much sand should be added so that the proportion of iron becomes 10%?

(a) 1 Kg (b) 200 gm
(c) 800 mgs (d) 1.8 Kg

**[SBI PO Examination, 1999]**

**73.** The price of a commodity rises from ₹6 per Kg to ₹7.50 per Kg. If the expenditure cannot increase, the percentage of reduction in consumption:

(a) 15 (b) 20
(c) 25 (d) 30

**[SSC (GL), 2011]**

**74.** There is a ratio of 5:4 between two numbers. If 40% of the first number is 12 then what would be the 50% of second number?

(a) 12 (b) 24
(c) 18 (d) Data inadequate

**[Bank of Baroda PO, 1999]**

**75.** When 30% of a number is added to another number the second number increase to its 140%. What is the ratio between the first and the second number?

(a) 3:4 (b) 4:3
(c) 3:2 (d) Data inadequate

**[Bank of Baroda PO, 1999]**

**76.** Suresh's monthly income is 30% more than that of Vinod. Vinod's monthly income is 20% less than that of Vinay. If the difference between the monthly incomes of Suresh and Vinay is ₹800, what is the monthly income of Vinod?

(a) ₹16000 (b) ₹20000
(c) ₹12000 (d) Data inadequate

**[Bank of Baroda PO, 1999]**

**77.** If 25% of a number is subtracted from a second number, the second number reduces to its five-sixths. What is the ratio between the first number and the second number?

(a) 2:3 (b) 3:2
(c) 1:3 (d) Data inadequate

**[SBI Associates PO, 1999]**

**78.** A petrol pump owner mixed leaded and unleaded petrol in such a way that the mixture contains 10% unleaded petrol. What quantity of leaded petrol should be added to 1 litre mixture so that the percentage of unleaded petrol becomes 5%?

(a) 1000 ml (b) 900 ml
(c) 1800 ml (d) None of these

**[SBI Associates PO, 1999]**

**79.** Out of a total of 85 children playing badminton or table tennis or both, total number of girls in the group is 70% of the total number of boys in the group. The number of boys playing only badminton is 50% of the number of boys and the total number of boys playing badminton is 60% of the total number of boys. The number of children playing only table tennis is 40% of the total number of children and a total of 12 children play badminton and table tennis both. What is the number of girls playing only badminton?

(a) 16 (b) 14
(c) 17 (d) Data inadequate

**[SBI Associates PO, 1999]**

**80.** If the numerator of a fraction is increased by 2 and the denominator is increased by 1, the fraction becomes $\frac{5}{8}$ and if the numerator of the same fraction is increased by 3 and the denominator is increased by 1 the fraction becomes $\frac{3}{4}$. What was the original fraction?

(a) $\frac{3}{7}$ (b) $\frac{2}{7}$
(c) $\frac{4}{7}$ (d) Data inadequate

**[Guwahati PO, 1999]**

**81.** When 50% of one number is added to a second number, the second number increases to its four-thirds. What is the ratio between the first number and the second number?

(a) 3:2 (b) 3:4
(c) 2:3 (d) Data inadequate

**[Guwahati PO, 1999]**

**82.** Raman scored 456 marks in an examination and Seeta got 54% marks in the same examination which is 24 marks less than Raman. If the minimum passing marks in the examination is 34%, then how much more marks did Raman score than the minimum passing makrs?

(a) 184 (b) 196
(c) 190 (d) 180

**[Bank of Baroda PO Examination, 2011]**

**83.** The difference between a discount of 35% and two successive discounts of 20% and 20% on a certain bill was ₹22. Find the amount of the bill.

(a) ₹1100 (b) ₹200
(c) ₹2200 (d) Data inadequate

**[BSRB Mumbai PO, 1999]**

**84.** Ram gave 40% of the amount to Deepak. Deepak in turn gave one-fourth of what he received from Ram to Subhash. After paying ₹200 to taxi driver out of the amount he got from Deepak, Subhash now has ₹600 left with him. How much amount did Ram have?

(a) ₹1200 (b) ₹4000
(c) ₹8000 (d) Data inadequate

**[BSRB Chennai PO, 2000]**

**85.** An article when sold for ₹960 fetches 20% profit. What would be the per cent profit/loss if 5 such articles are sold for ₹825 each?

(a) 3.125% profit (b)3.125% loss
(c) Neither profit nor loss (d)16.5% profit

**[BSRB Bhopal PO, 2000]**

**86.** Rakesh solved 80% of the questions in an examination correctly. If out of 41 questions solved by Rakesh, 37 questions are correct and of the remaining questions out of 8 questions 5 questions have been solved by Rakesh correctly then find the total number of questions asked in the examination.

(a) 75 (b) 65
(c) 60 (d) Cannot be determined

**[BSRB Bangalore PO, 2000]**

**87.** In a class of 60 children, 30% children can speak only English, 20% Hindi and English both and rest

of the children can speak only Hindi. How many children can speak Hindi?

(a) 42 (b) 36
(c) 30 (d) 48

**[BSRB Patna PO, 2001]**

**88.** The ratio of males and females in a city is 7:8 and the percentage of children among males and females is 25% and 20%, respectively. If the number of adult females in the city is 156800, what is the total population?

(a) 245000 (b) 367500
(c) 196000 (d) 171500

**[BSRB Patna PO, 2001]**

**89.** X, a businessman, had income in the year 1995 such that he earned a profit of 20% on his investment in the business. In the year 1996 his investment was less by ₹5000 but still had the same income (Income = Investment + Profit) as that in 1995. Thus the per cent profit earned in 1996 increased by 26%. What was his investment in 1995?

(a) ₹100000 (b) ₹100500
(c) ₹105000 (d) Data inadequate

**[SBI PO, 2001]**

**90.** The production of a company has ups and downs every year. The production increase for two consecutive years consistently by 15% and in the third year it decreases by 10%. Again, in the next two years it increases by 15% each year and decreases by 10% in the third year. If we start counting from the year 1990 approximately what will be the effect on the production of the company in 1994?

(a) 37% increase (b) 42% increase
(c) 52% increase (d) 32% increase

**[Corporation Bank PO, 2002]**

**91.** In an Entrance Examination Ritu scored 56% marks, Smita scored 92% marks and Rina scored 634 marks. The maximum marks of the examination are 875. What are the average marks scored by all the three girls together?

(a) 929 (b) 815
(c) 690 (d) 643

**[IBPS Bank PO, 2011]**

**92.** In a test, a candidate secured 468 marks out of maximum marks '*A*'. If the maximum marks '*A*' were converted to 700 marks, he would have secured 336 marks. What were the maximum marks of the test?

(a) 775 (b) 875
(c) 975 (d) 1075

**[IBPS Bank PO, 2011]**

**93.** The market price of a watch is ₹800. A shopkeeper gives two successive discounts and sells the watch for ₹612. If the first discount is 10%, then the second discount is:

(a) 12% (b) 20%
(c) 15% (d) 10%

**[SSC (GL) Prel. Examination, 2002]**

**94.** An HR Company employs 4800 people, out of which 45% are males and 60% of the males are either 25 years or older. How many males are employed in the company who are younger than 25 years?

(a) 2640 (b) 2160
(c) 1296 (d) 864

**[IBPS Bank PO, 2011]**

**95.** Six-elevenths of a number is equal to 22% of second number. Second number is equal to the one-fourth of third number. The value of the third number is 2400. What is the 45% of first number?

(a) 109.8 (b) 111.7
(c) 117.6 (d) None of these

**[IBPS Bank PO, 2011]**

**96.** Bhawna decided to donate 12% of her salary to an orphanage. On the day of donation she changed her mind and donated ₹2400 which was 125% of what she had decided earlier. How much is Bhawna's salary?

(a) ₹14750 (b) ₹16000
(c) ₹18500 (d) Cannot be determined

**[Uttrakhand GBO PO, 2007]**

**97.** If the numerator of a fraction is increased by 400% and the denominator is increased by 500%. The resultant fraction is 20/27. What was the original fraction?

(a) $\frac{9}{8}$ (b) $\frac{11}{12}$
(c) $\frac{3}{4}$ (d) None of these

**[New Indian Insurance PO, 2009]**

**98.** Two numbers are less than a third number by 30% and 37%, respectively. How much per cent is the second number less than the first?

(a) 7% (b) 10%
(c) 4% (d) 3%

**[SSC (GL) Prel. Examination, 2002]**

**99.** 8% of the voters in an election did not cast their votes. In this election, there were only two candidates. The winner by obtaining 48% of the total votes defeated his rival by 1100 votes. The total number of voters in the election was:

(a) 2100 (b) 23500
(c) 22000 (d) 27500

**[SSC (GL) Prel. Examination, 2003]**

**100.** A candidate appearing for an examination has to secure 35% marks to pass. But he secured only 40 marks and failed by 30 marks. What would be the maximum marks of test?

(a) 280 (b) 180
(c) 200 (d) 150

**[Corporation Bank PO, 2009]**

**101.** In a test, minimum passing percentage for girls and boys is 35% and 40% respectively. A boy scored 483 marks and failed by 117 marks. What are the minimum passing marks for girls?

(a) 425 (b) 520
(c) 500 (d) None of these

**[CBI (PO), 2010]**

**102.** A trader marked the selling price of an article at 10% above the cost price. At the time of selling he allows certain discount and suffers a loss of 1%. He allowed a discount of:

(a) 11% (b) 10%
(c) 9% (d) 10.5%

**[SSC (GL) Prel. Examination, 2003]**

**103.** A person gave 20% of his income to his elder son, 30% of the remaining to the younger son and 10% of the balance he denoted to a trust. He is left with ₹10080. His income was:

(a) ₹50000 (b) ₹40000
(c) ₹30000 (d) ₹20000

**[SSC (GL) Prel. Examination, 2003]**

**104.** A reduction of 20% in the price of rice enables a person to buy 3.5 Kg more rice for ₹385. The original price of rice per Kg is:

(a) ₹20 (b) ₹22.50
(c) ₹25 (d) ₹27.50

**[SSC (GL) Prel. Examination, 2003]**

**105.** The price of an article is raised by 30% and then two successive discounts of 10% each are allowed. Ultimately the price of the article is:

(a) Increased by 10% (b) Increased by 5.3%
(c) Decreased by 3% (d) Decreased by 5.3%

**[SSC (GL) Prel. Examination, 2003]**

**106.** A tradesman gives 4% discount on the marked price and gives 1 article free for buying every 15 articles and thus gains 35%. The marked price is increased above the cost price by:

(a) 40% (b) 39%
(c) 50% (d) 20%

**[SSC (GL) Prel. Examination, 2003**

**107.** The number that is to be added to 10% of 320 to have the sum as 30% of 230 is:

(a) 37 (b) 32
(c) 23 (d) 73

**[SSC, 2014]**

**108.** The strength of a school increases and decreases in every alternate year by 10%. It started with increase in 2000. Then the strength of the school in 2003 as compared to that in 2000 was:

(a) Increased by 8.9%
(b) Decreased by 8.9%
(c) Increased by 9.8%
(d) Decreased by 9.8%

**[SSC, 2014]**

**109.** Two years ago, the value of a motorbike was ₹62,500. If the value depreciates by 4% every year, now its value is:

(a) ₹56,700 (b) ₹57,600
(c) ₹57,500 (d) ₹55,700

**[SSC, 2014]**

**110.** A number increased by $22\frac{1}{2}\%$ gives 98. The number is:

(a) 45 (b) 18
(c) 80 (d) 81

**[SSC, 2013]**

**111.** In an examination A got 25% marks more than B, B got 10% less than C and C got 25% more than D. If D got 320 marks out of 500, the marks obtained by A were:

(a) 405 (b) 450
(c) 360 (d) 400

**[SSC, 2013]**

**112.** Three sets of 40, 50 and 60 students appeared for an examination and the pass percentage was 100, 90 and 80, respectively. The pass percentage of the whole set is:

(a) $88\frac{2}{3}$  (b) $84\frac{2}{3}$
(c) $88\frac{1}{3}$  (d) $84\frac{1}{3}$

**[SSC, 2013]**

**113.** A clerk received annual salary of ₹3,660 in the year 1975. This was 20% more than his salary in 1974. What was his salary in 1974?

(a) ₹3,005  (b) ₹3,000
(c) ₹3,500  (d) ₹3,050

**[SSC Assistant Grade III, 2013]**

**114.** Out of his total income, Mr. Kapur spends 20% on house rent and 70% of the rest on household expenses. If he saves ₹1,800, what is his total income?

(a) 7,800  (b) 7,000
(c) 8,000  (d) 7,500

**[SSC Assistant Grade III, 2013]**

**115.** Rama's expenditure and savings are in the ratio3:2. His income increases by 10 per cent. His expenditure also increases by 12%. His savingsincreases by:

(a) 7%  (b) 10%
(c) 9%  (d) 13%

**[SSC Assistant Grade III, 2012]**

**116.** If the numerator of a fraction is increased by 150% and the denominator of the fraction is increased by 350%, the resultant fraction is $\frac{25}{51}$, what is the original fraction?

(a) $\frac{11}{17}$  (b) $\frac{11}{15}$
(c) $\frac{15}{17}$  (d) $\frac{13}{15}$
(e) None of these

**[Corporation Bank PO, 2010]**

**117.** Two numbers are 30% and 40% more than the third number respectively. The first number is $x$% of the second. Then $x$ = ?

(a) $105\frac{2}{13}$  (b) 140
(c) $105\frac{5}{7}$  (d) $92\frac{6}{7}$

**[SSC Assistant Grade III, 2012]**

**118.** The price of cooking oil has increased by 25%. The percentage of reduction that a family should effect in the use of cooking oil, so as not to increase the expenditure on this account, is:

(a) 15%  (b) 20%
(c) 25%  (d) 30%

**[SSC Assistant Grade III, 2012]**

**119.** In an examination, 52% of the candidates failed in English and 42% failed in Mathematics. If 17% failed in both the subjects, then the percentage of candidates, who passed in both the subjects, was:

(a) 23  (b) 21
(c) 25  (d) 22

**[SSC, 2012]**

**120.** In an election there were only two candidates. One of the candidates secured 40% of votes and is defeated by the other candidate by 298 votes. The total number of votes polled is:

(a) 745  (b) 1460
(c) 1490  (d) 1500

**[SSC, 2012]**

**121.** A jar contains 10 red marbles and 30 green ones. How many red marbles must be added to the jar so that 60% of the marbles will be red?

(a) 25  (b) 30
(c) 35  (d) 40

**[SSC, 2011]**

**122.** If a number multiplied by 25% of itself gives a number which is 200% more than number, then the number is:

(a) 12  (b) 16
(c) 20  (d) 24

**[SSC, 2011]**

**123.** The price of onions has been increased by 50%. In order to keep the expenditure on onions the same the percentage of reduction in consumption has to be:

(a) 50%  (b) $33\frac{1}{3}$%
(c) 33%  (d) 30%

**[SSC, 2011]**

**124.** When the price of a toy was increased by 20%, the number of toys sold was decreased by 15%. What was its effect on the total sales of the shop?

(a) 2% increase  (b) 2% decrease
(c) 4% increase  (d) 4% decrease

**[SSC, 2010]**

**125.** Krishnamurthy earns ₹15000 per month and spends 80% of it. Due to pay revision, his monthly income has increased by 20% but due to price rise, he has to spend 20% more. His new savings are:

(a) ₹3,400 (b) ₹3,000
(c) ₹3,600 (d) ₹4,000

**[SSC, 2010]**

**126.** Two numbers are respectively $12\frac{1}{2}$% and 25%more than a third number. The first number is how much per cent of the second number?

(a) 90 (b) 87.5
(c) 25 (d) 12.5

**[SSC, 2010]**

**127.** Population of a town increases 2.5% annually but is decreased by 0.5% every year due to migration. What will be the percentage of increase in 2 years?

(a) 5 (b) 4.04
(c) 4 (d) 3.96

**[SSC, 2010]**

**128.** A merchant has announced 25% rebate on prices of ready-made garments at the time of sale. If a purchaser needs to have a rebate of ₹400, then how many shirts, each costing ₹320 should he purchase?

(a) 10 (b) 7
(c) 6 (d) 5

**[SSC, 2010]**

**129.** A reduction of 10% in the price of tea enables a dealer to purchase 25 Kg more tea for ₹22500. What is the reduced price per Kg of tea?

(a) ₹70 (b) ₹80
(c) ₹90 (d) ₹100

**[SSC, 2010]**

**130.** Ram donated 4% of his income to a charity and deposited 10% of the rest in a Bank. If now he has ₹8640 left with him, then his income is:

(a) ₹12,500 (b) ₹12,000
(c) ₹10,500 (d) ₹10,000

**[SSC, 2010]**

**131.** 134% of 3894 + 38.94 of l34 = ?

(a) 11452 (b) 10000
(c) 10452 (d) 1100
(e) None of these

**[IBPS PO/MT, 2013]**

**132.** 23% of 6783 + 57% of 8431 = ?

(a) 6460 (b) 6420
(c) 6320 (d) 6630
(e) 6360

**[IBPS PO/MT, 2012]**

**133.** The sum of three consecutive numbers is 2262. What is 41% of the highest number?

(a) 301.51 (b) 303.14
(c) 308.73 (d) 306.35
(e) 309.55

**[IBPS PO/MT, 2012]**

**134.** Akash scored 73 marks in subject A. He scored 56% marks in subject B and X marks in subject C. Maximum marks in each subject were 150. The overall percentage marks obtained by Akash in all three subjects together was 54%. How many marks did he score in subject C?

(a) 84 (b) 86
(c) 79 (d) 73
(e) None of these

**[IBPS PO/MT, 2012]**

**Directions (Q. 135):** What approximate value should come in place of question mark (?) in the following question? (Note: You are not expected to calculate the exact value.)

**135.** 39.897% of 4331 + 58.779% of 5003 =?

(a) 4300 (b) 4500
(c) 4700 (d) 4900
(e) 5100

**[IBPS PO/MT, 2011]**

**136.** Ramola's monthly income is three times Ravina's monthly income. Ravina's monthly income is fifteen percent more than Ruchira's monthly income. Ruchira's monthly income is ₹32,000. What is Ramola's annual income?

(a) ₹1,10.400 (b) ₹13,24,800
(c) ₹36,800 (d) ₹52,200
(e) None of these

**[IBPS PO/MT, 2011]**

**137.** In a test, a candidates secured 468 marks out of maximum marks 'A'. Had the maximum marks 'A' converted to 700, he would have secured 336 marks. What was the maximum marks of the test?

(a) 775 (b) 875
(c) 975 (d) 1075
(e) None of these

**[IBPS PO/MT, 2011]**

**138.** Six-elevenths of a number is equal to 22 per cent of the second number. The second number is equal to one-fourth of the third number. The value of the third number is 2400. What is 45% of the first number?

(a) 109.8 (b) 111.7
(c) 117.6 (d) 123.4
(e) None of these

**[IBPS PO/MT, 2011]**

**Directions (Q. 139):** What will come in place of question mark(?) in the following question?

**139.** 32.05% of 259.99 =?

(a) 92 (b) 88
(c) 78 (d) 90
(e) 83

**[SBI Associates Banks PO, 2011]**

**140.** Mr X invested a certain amount in Debt and Equity Funds in the ratio of 4:5. At the end of one year, he earned a total dividend of 30% on his investment. After one year, he reinvested the amount including the dividend in the ratio of 6:7 in Debt and Equity Funds. If the amount reinvested in Equity Funds was ₹94,500, what was the original amount invested in Equity Funds?

(a) ₹75,000 (b) ₹81,000
(c) ₹60,000 (d) ₹65,000
(e) None of these

**[SBI Associates Banks PO, 2011]**

**141.** The product of one-third of a number and 150% of another number is what per cent of the product of the original numbers?

(a) 80% (b) 50%
(c) 75% (d) 120%
(e) None of these

**[SBI Associates Banks PO, 2011]**

**142.** Mr Shamin's salary increases every year by 10% in June. If there is no other increase or reduction in the salary and his salary in June 2011 was ₹22,385, what was his salary in June 2009?

(a) ₹18,650 (b) ₹18.000
(c) ₹19,250 (d) ₹18,500
(e) None of these

**[SBI Associates Banks PO, 2011]**

**143.** How many students passed in first class?

**Statements:**

**I.** 85% of the students who appeared in examination have passed either in first class or in second class or in pass class.

**II.** 750 students have passed in second class.

**III.** The number of students who passed in pass class is 28% of those passed in second class.

(a) All I, II and III
(b) Only I and III
(c) Only II and III
(d) Question cannot be answered even with information in all three statements.
(e) None of these

**[SBI Associates Banks PO, 2011]**

**144.** 34.5% of 1800 + 12.4% of 1500 = $(?)^3$ + 78:

(a) 27 (b) 9
(c) 81 (d) 162
(e) None of these

**[Indian Overseas Bank PO, 2011]**

**145.** 67% of 801 – 231.17 = ? –23% of 789:

(a) 490 (b) 440
(c) 540 (d) 520
(e) 590

**[Indian Overseas Bank PO, 2011]**

**146.** Five-ninths of a number is equal to twenty five per cent of the second number. The second number is equal to one-fourth of the third number. The value of the third number is 2960. What is 30 per cent of the first number?

(a) 88.8 (b) 99.9
(c) 66.6 (d) Cannot be determined
(e) None of these

**[Indian Overseas Bank PO, 2011]**

**147.** Dinesh's monthly income is four times Suresh's monthly income. Suresh's monthly income is twenty per cent more than Jyoti's monthly income. Jyoti's monthly income is ₹22,000. What is Dinesh's monthly income?

(a) ₹1,06,500 (b) ₹1,05,600
(c) ₹1,04,500 (d) ₹1,05,400
(e) None of these

**[Indian Overseas Bank PO, 2011]**

**148.** In a school there are 250 students, out of whom 12 per cent are girls. Each girl's monthly fee is ₹450 and each boy's monthly fee is 24 per cent more than that of a girl. What is the total monthly fee of girls and boys together?

(a) ₹1,36,620 (b) ₹1,36,260
(c) ₹1,32,660 (d) ₹1,32,460
(e) None of these

**[Indian Overseas Bank PO, 2011]**

**149.** A sum of ₹731 is distributed among A, B and C, suchthat A receives 25% more than B and B receives 25% less than C. What is C's share in the amount?

(a) ₹172 (b) ₹200
(c) ₹262 (d) ₹258
(e) None of these

**[Andhra Bank PO, 2011]**

**150.** Pradeep invested 20% more than Mohit. Mohit invested 10% less than Raghu. If the total sum of their investment is ₹17,880, how much amount did Raghu invest?

(a) ₹6,000 (b) ₹8,000
(c) ₹7,000 (d) ₹5,000
(e) None of these

**[Corporation Bank PO, 2011]**

**151.** If the numerator of a fraction is increased by 150% and the denominator of the fraction is increase by 300%, the resultant fraction is $\frac{5}{18}$. What is the original fraction?

(a) $\frac{4}{9}$ (b) $\frac{4}{5}$
(c) $\frac{8}{9}$ (d) $\frac{8}{11}$
(e) None of these

**[Punjab and Sind Bank PO, 2011]**

**152.** In a test, minimum passing percentage for girls and boys is 35% and 40% respectively. A boy scored 483 marks and failed by 117 marks. What is the minimum passing marks for girls?

(a) 425 (b) 520
(c) 500 (d) 625
(e) None of these

**[Central Bank of India PO, 2010]**

**153.** Twelve per cent of Kaushal's monthly salary is equal to sixteen per cent of Nandini's monthly salary. Suresh's monthly salary is half that of Nandini's monthly salary. If Suresh's annual salary is ₹1.08 Lakhs, what is Kaushal's monthly salary?

(a) ₹20,000 (b) ₹18,000
(c) ₹26,000 (d) ₹24,000
(e) None of these

**[Central Bank of India PO, 2010]**

**154.** Rita invested 25% more than Sunil. Sunil invested 30% less than Abhinav, who invested ₹6,000. What is the ratio of the amount that Rita invested to the total amount invested by all of them together?

(a) 35:104 (b) 13:29
(c) 101:36 (d) 35:103
(e) None of these

**[Punjab and Sind Bank PO, 2010]**

**155.** 15% of 578 + 22.5% of 644 = ?

(a) 213.4 (b) 233.6
(c) 231.8 (d) 231.6
(e) None of these

**[Indian Bank PO, 2010]**

**156.** Sonu invested 10% more than Mona. Mona invested 10% less than Raghu. If the total sum of their investments is ₹5,780, how much amount did Raghu invest?

(a) ₹2,010 (b) ₹2,000
(c) ₹2,100 (d) ₹2,210
(e) None of these

**[Indian Bank PO, 2010]**

**157.** Rahul spends 50% of his monthly income on household items, 20% of his monthly income on buying clothes, 5% of his monthly income on medicines and the remaining amount of ₹11,250 he saves. What is Rahul's monthly income?

(a) ₹38,200 (b) ₹34,000
(c) ₹41,600 (d) ₹45,000
(e) None of these

**[IDBI Bank PO, 2009]**

**158.** Asha's monthly income is 60% of Deepak's monthly income and 120% of Maya's monthly income. What is Maya's monthly income if Deepak's monthly income is ₹78,000?

(a) ₹39,000 (b) ₹42,000
(c) ₹36,000 (d) Cannot be determined
(e) None of these

**[NABARD Bank Officer, 2009]**

**159.** If the numerator of a fraction is increased by 240% and the denominator of the fraction is decreased by 50%, the resultant fraction is $2\frac{5}{6}$, what is the original fraction?

(a) $\frac{1}{4}$ (b) $\frac{2}{3}$
(c) $\frac{5}{12}$ (d) $\frac{4}{11}$
(e) None of these

**[NABARD Bank Officer, 2009]**

**160.** 40% of 60% of $\frac{3}{5}$ of a number is 504. What is 25% of $\frac{2}{5}$ of that number?

(a) 130 (b) 175
(c) 360 (d) 350
(e) None of these

**[NABARD Bank Officer, 2009]**

**161.** In a test consisting of 80 questions carrying one markeach, Arpita answers 65% of the first 40 questions correctly. What percent of the other 40 questions does she need to answer correctly to score 75% on the entire test?

(a) 60 (b) 80
(c) 75 (d) 40
(e) None of these

**[NABARD Bank Officer]**

**162.** Aman's expense is 30% more than Vimal's and Vimal's expense is 10% less than Raman's. If the sum of their expenses is ₹6,447, then what would be Aman's expense?

(a) ₹2,200 (b) ₹2,457
(c) ₹1,890 (d) ₹ 2,100
(e) None of these

**[Corporation Bank PO, 2009]**

**163.** A candidate appearing for an examination has to secure 35% marks to pass. But he secured only 40 marks and failed by 30 marks. What would be the maximum marks of test?

(a) 280 (b) 180
(c) 200 (d) 150
(e) 210

**[Corporation Bank PO, 2009]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (b) | **3.** (b) | **4.** (c) | **5.** (b) | **6.** (c) | **7.** (b) | **8.** (a) | **9.** (c) | **10.** (c) | **11.** (c) | **12.** (b) | **13.** (c) |
| **14.** (a) | **15.** (b) | **16.** (b) | **17.** (c) | **18.** (b) | **19.** (b) | **20.** (c) | **21.** (b) | **22.** (c) | **23.** (b) | **24.** (c) | **25.** (a) | **26.** (b) |
| **27.** (c) | **28.** (b) | **29.** (b) | **30.** (a) | **31.** (b) | **32.** (a) | **33.** (b) | **34.** (a) | **35.** (b) | **36.** (c) | **37.** (d) | **38.** (b) | **39.** (b) |
| **40.** (b) | **41.** (a) | **42.** (c) | **43.** (a) | **44.** (a) | **45.** (b) | **46.** (b) | **47.** (a) | **48.** (a) | **49.** (c) | **50.** (a) | **51.** (a) | **52.** (b) |
| **53.** (c) | **54.** (c) | **55.** (b) | **56.** (c) | **57.** (c) | **58.** (b) | **59.** (a) | **60.** (b) | **61.** (b) | **62.** (c) | **63.** (b) | **64.** (b) | **65.** (a) |
| **66.** (b) | **67.** (a) | **68.** (a) | **69.** (c) | **70.** (a) | **71.** (a) | | | | | | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (c) | **3.** (b) | **4.** (e) | **5.** (d) | **6.** (d) | **7.** (d) | **8.** (a) | **9.** (b) | **10.** (a) | **11.** (c) | **12.** (a) | **13.** (a) |
| **14.** (b) | **15.** (b) | **16.** (b) | **17.** (e) | **18.** (c) | **19.** (e) | **20.** (a) | **21.** (d) | **22.** (b) | **23.** (c) | **24.** (d) | **25.** (c) | **26.** (d) |
| **27.** (a) | **28.** (e) | **29.** (e) | **30.** (c) | **31.** (a) | **32.** (c) | **33.** (b) | **34.** (d) | **35.** (c) | **36.** (d) | **37.** (c) | **38.** (a) | **39.** (d) |
| **40.** (b) | **41.** (c) | **42.** (b) | **43.** (d) | **44.** (c) | **45.** (b) | **46.** (c) | **47.** (a) | **48.** (b) | **49.** (b) | **50.** (a) | **51.** (d) | **52.** (d) |
| **53.** (b) | **54.** (d) | **55.** (b) | **56.** (b) | **57.** (c) | **58.** (b) | **59.** (e) | **60.** (d) | **61.** (a) | **62.** (a) | **63.** (c) | **64.** (b) | **65.** (b) |
| **66.** (d) | **67.** (c) | **68.** (d) | **69.** (b) | **70.** (d) | **71.** (d) | **72.** (a) | **73.** (b) | **74.** (a) | **75.** (b) | **76.** (a) | **77.** (a) | **78.** (a) |
| **79.** (b) | **80.** (d) | **81.** (c) | **82.** (a) | **83.** (c) | **84.** (c) | **85.** (a) | **86.** (b) | **87.** (a) | **88.** (b) | **89.** (c) | **90.** (a) | **91.** (d) |
| **92.** (c) | **93.** (c) | **94.** (d) | **95.** (d) | **96.** (b) | **97.** (d) | **98.** (b) | **99.** (d) | **100.** (c) | **101.** (d) | **102.** (b) | **103.** (d) | **104.** (d) |
| **105.** (b) | **106.** (c) | **107.** (a) | **108.** (a) | **109.** (b) | **110.** (c) | **111.** (b) | **112.** (a) | **113.** (d) | **114.** (d) | **115.** (a) | **116.** (c) | **117.** (d) |
| **118.** (b) | **119.** (a) | **120.** (c) | **121.** (c) | **122.** (a) | **123.** (b) | **124.** (a) | **125.** (c) | **126.** (a) | **127.** (c) | **128.** (d) | **129.** (c) | **130.** (d) |
| **131.** (c) | **132.** (e) | **133.** (e) | **134.** (b) | **135.** (c) | **136.** (b) | **137.** (c) | **138.** (e) | **139.** (e) | **140.** (a) | **141.** (b) | **142.** (d) | **143.** (d) |
| **144.** (b) | **145.** (a) | **146.** (b) | **147.** (b) | **148.** (b) | **149.** (e) | **150.** (a) | **151.** (a) | **152.** (e) | **153.** (d) | **154.** (d) | **155.** (d) | **156.** (b) |
| **157.** (d) | **158.** (a) | **159.** (c) | **160.** (d) | **161.** (e) | **162.** (b) | **163.** (c) | | | | | | |

# EXPLANATORY ANSWERS

## EXERCISE-I

**1. (a)** $5\frac{1}{4} = \frac{21}{4} = \frac{21}{4} \times 100 = 525\%$

**2. (b)** $0.005 = \frac{5}{1000} = \frac{5}{1000} \times 100 = \frac{1}{2}\%$

**3. (b)** $6\frac{2}{3}\% = \frac{\left(\frac{20}{3}\right)}{100} = \left(\frac{20}{3} \times \frac{1}{100}\right) = \frac{1}{15}$.

**4. (c)** $0 \cdot 6\% = \frac{0 \cdot 6}{100} = \frac{6}{1000} = \frac{3}{500}$.

**5. (b)** $.025 = \left(\frac{25}{1000} \times 100\right)\% = 2.5\%$

**6. (c)** Let $x\%$ of $12 = 84$

$\Rightarrow \frac{x}{100} \times 12 = 84$

$\Rightarrow x = \frac{84 \times 100}{12} = 700.$

$\therefore$ 700% of 12 is 84.

**7. (b)** $\frac{7}{8} = \left(\frac{7}{8} \times 100\right)\% = \frac{175}{2}\% = 87\frac{1}{2}\%$

**8. (a)** $8\frac{1}{3}\% = \frac{25}{3}\% = \frac{25}{3} \times \frac{1}{100} = \frac{1}{12}$.

**9. (c)** $37\frac{1}{2}\%$ of ₹48 $= 48 \times \frac{75}{2 \times 100} =$ ₹18.

**10. (c)** Let $x\%$ of $\frac{2}{7} = \frac{1}{35}$

$\Rightarrow x = \frac{100 \times 7}{2 \times 35} = 10.$

$\therefore$ 10% of $\frac{2}{7}$ is $\frac{1}{35}$.

**11. (c)** Let 75% of $480 = x \times 15$.

Then, $\frac{75}{100} \times 480 = 15x$

or, $x = \frac{75 \times 480}{100 \times 15} = 24.$

**12. (b)** Let 200% of $x = 90 \Rightarrow \frac{200}{100} \times x = 90$

$\Rightarrow x = \frac{100 \times 90}{200} = 45.$

$\therefore$ 80% of $45 = \frac{80}{100} = 45 = 36.$

**13. (c)** Let the number be $x$, then

$37\frac{1}{2}\%$ of $x = 45 \Rightarrow \frac{75}{2} \times \frac{1}{100} \times x = 45$

or, $\frac{3}{8}x = 45 \Rightarrow x = \frac{45 \times 8}{3} = 120.$

$\therefore$ $87\frac{1}{2}\%$ of $120 = \frac{75}{2} \times \frac{1}{100} \times 120 = 105.$

**14. (a)** Let $x \times 15 = 37.5\%$ of 220

$\Rightarrow 15x = \frac{37.5}{100} \times 220$

$\Rightarrow x = \frac{37.5 \times 220}{15 \times 100} = 5.5.$

**15. (b)** Let $x\%$ of 4 Km = 8 metre

$\Rightarrow \frac{x}{100} \times 4000 = 8$ ($\because$ 1 Km = 1000 metre)

$\Rightarrow x = \frac{8 \times 100}{4000} = \frac{1}{5} = 0.2$

$\therefore$ 0.2% of 4 Km = 8 metre.

**16. (b)** $x\%$ of $y + y\%$ of $x = \left(\frac{x}{100} \times y\right) + \left(\frac{y}{100} \times x\right)$

$= \frac{2}{100}xy = 2\%$ of $xy$.

**17. (c)** $0.35\% = 0 \cdot 35 \times \frac{1}{100} = 0.0035.$

**18. (b)** We have, 8% of $x$ = 4% of $y$

$\Rightarrow \frac{8}{100} \times x = \frac{4}{100} \times y \Rightarrow x = \left(\frac{4}{100} \times \frac{100}{8}\right)y = \frac{y}{2}$.

$\therefore$ 20% of $x = \frac{20}{100} \times x = \frac{20}{100} \times \frac{y}{2}$

$= \frac{10}{100} \times y$

$= 10\%$ of $y$.

**19. (b)** Let the missing figure be $a$.

We have, $\frac{x}{100} \times y + \frac{a}{100} \times x = \frac{x}{100} \times (x + y)$

$\Rightarrow xy + ax = x(x + y)$

$\Rightarrow ax = x^2$. $\therefore$ $a = x$.

**20. (c)** We have, $x = 125\%$ of $y \Rightarrow x = \frac{125}{100}y = \frac{5}{4}y$

or, $y = \frac{4}{5}x = 0.8x.$

**21. (b)** 25% of 25% $= \frac{25}{100} \times \frac{25}{100} = \frac{625}{10000} = 0.0625.$

**22.** **(c)** Required number = 80 – 60% of 80

$= 80 - \frac{60}{100} \times 80 = 32.$

**23.** **(b)** 20% of 30% of 20% of 850

$= \frac{20}{100}\times\frac{30}{100}\times\frac{20}{100}\times 850 = \frac{1020}{100} = ₹10.20.$

**24.** **(c)** $16\frac{2}{3}\% = \frac{50}{3}\times\frac{1}{100}\times\frac{1}{6} = 0.167 < 0.3.$

$6\frac{2}{3}\% = \frac{20}{3}\times\frac{1}{100} = \frac{1}{15} = 0.067 < 0.3.$

$\therefore$ 0.3 is greatest.

**25.** **(a)** $40\% \text{ of } 20\% = \frac{40}{100}\times\frac{20}{100} = \frac{8}{100} = 8\%$

$30\% \text{ of } 25\% = \frac{30}{100}\times\frac{25}{100} = \frac{75}{100} = 7.5\%$

and, $50\% \text{ of } 28\% = \frac{50}{100}\times\frac{28}{100} = \frac{14}{100} = 14\%$

$\therefore$ (40% of 20% + 30% of 25% + 50% of 28%)
= 8% + 7.5% + 14% = 29.5%.

**26.** **(b)** We have, $\frac{90}{100} \times A = \frac{30}{100} \times B$

$= \frac{30}{100} \times \frac{x}{100} \times A$

$\therefore\ x = \left(100\times\frac{100}{30}\times\frac{90}{100}\right) = 300.$

**27.** **(c)** Let 1 quintal 25 Kg = $x$% of 1 metric tonne

$\Rightarrow x\% = \frac{125}{1000} = \frac{1}{8} = \frac{1}{8} \times 100\%$

$= 12\frac{1}{2}\%$

**28.** **(b)** We have, 12% of $x$ = 6% of $y$

$\Rightarrow$ 2% of $x$ = 1% of $y$

$\Rightarrow$ (2 × 9)% of $x$ = (1 × 9)% of $y$

$\Rightarrow$ 18% of $x$ = 9% of $y$.

**29.** **(b)** Here, $x = 20$.

$\therefore$ Required answer $= \left(\frac{x}{100+x}\times 100\right)\%$

$= \left(\frac{20}{100+20}\times 100\right)\% = 16\frac{2}{3}\%$

**30.** **(a)** Here, $x = 25$.

$\therefore$ Required answer $= \left(\frac{x}{100-x}\times 100\right)\%$

$= \left(\frac{25}{100-25}\times 100\right)\%$

$= 33\frac{1}{3}\%$

**31.** **(b)** Here, $l = 7$ and $m = 28$.

$\therefore$ First number $= \frac{1}{m} \times 100\%$ of second number

$= \frac{7}{28} \times 100\%$ of second number

or, 25% of second number.

**32.** **(a)** Here, $x = 60$ and $y = 20$.

$\therefore$ Second number $= \left(\frac{100+y}{100+x}\times 100\right)\%$ of the first

$= \left(\frac{100+20}{100+60}\times 100\right)\%$ of the first

i.e., 75% of the first.

**33.** **(b)** Here, $x = 30$ and $y = 37$.

$\therefore$ Second number $= \left(\frac{100-y}{100-x}\times 100\right)\%$ of the first

$= \left(\frac{100-37}{100-30}\times 100\right)\%$ of the first

i.e., 90% of the first.

**34.** **(a)** Here $x = 20$ and $y = 10$.

$\therefore$ First number $= \left(\frac{100+x}{100+y}\times 100\right)\%$ of the second

$= \left(\frac{100+20}{100+10}\times 100\right)\%$ of the second

i.e., $109\frac{1}{11}\%$ of the second.

$\therefore$ The first number is $9\frac{1}{11}\%$ more than the second.

**35.** **(b)** Reduction in consumption

$= \left(\frac{P}{100+P}\times 100\right)\%$

$= \left(\frac{15}{100+15}\times 100\right)\%$ or $13\frac{1}{23}\%$

**36.** **(c)** Increase in consumption

$= \left(\frac{P}{100-P}\times 100\right)\%$

$= \left(\frac{10}{100-10}\times 100\right)\%$ or $11\frac{1}{9}\%$

**37.** **(d)** Here, $x = 20$ and $y = -20$.

$\therefore$ The net % change in value

$= \left(x+y+\frac{xy}{100}\right)\%$

$= \left(20-20-\frac{20\times 20}{100}\right)\%$ or –4%.

Since the sign is –ve, there is decrease in value by 4%

**38.** **(b)** Here, $x = -50$ and $y = 50$.

$\therefore$ The net % change in wages

$= \left(x + y + \dfrac{xy}{100}\right)\%$

$= \left(-50 + 50 - \dfrac{50 \times 50}{100}\right)\%$

or, $-25\%$.

Since the sign is –ve, he has a loss of 25%

**39.** **(b)** Here, $x = -20$ and $y = -25$.

$\therefore$ The net % change in population

$= \left(x + y + \dfrac{xy}{100}\right)\%$

$= \left(-20 - 25 + \dfrac{20 \times 25}{100}\right)$ or $-40\%$

Since the sign is –ve, the population is decreased by 40% after two years.

**40.** **(b)** The equivalent discount of two successive discounts of 20% and 20%

$= \left(x + y + \dfrac{xy}{100}\right)\%$

$= \left(-20 - 20 + \dfrac{20 \times 20}{100}\right)$ % or $-36\%$

Given: 36% – 35% = ₹22.

$\therefore$ Amount of the bill = 22 × 100 = ₹2200.

**41.** **(a)** Here, $x = 25$ and $y = -12$.

$\therefore$ The net% change in original price

$= \left(x + y + \dfrac{xy}{100}\right)$

$= \left(25 - 12 - \dfrac{25 \times 12}{100}\right)$ % or 10%

Since the sign is +ve, there is a profit of 10%

**42.** **(c)** The equivalent discount of two successive discounts of 20% and 10%

$= \left(x + y + \dfrac{xy}{100}\right)\% = \left(-20 - 10 + \dfrac{20 \times 10}{100}\right)$ % or 28%

$\therefore$ Discount on the list price of the radio offered by the first shopkeeper

= 28% of 1000 = $\dfrac{28}{100} \times 1000$ = ₹280.

Also, the equivalent discount of two successive discounts of 15% and 15%

$= \left(x + y + \dfrac{xy}{100}\right)\%$

$= \left(-15 - 15 + \dfrac{15 \times 15}{100}\right)$ % or $27\dfrac{3}{4}\%$

$\therefore$ Discount on the list price of radio offered by the second shopkeeper

$= 27\dfrac{3}{4}\%$ of 1000 = $\dfrac{111}{400} \times 1000$

= ₹277.50.

$\therefore$ Difference in discounts offered by the two shopkeepers = ₹280 – ₹277.50 = ₹2.50.

**43.** **(a)** Since tax × consumption = revenue

$\therefore$ Net % change in revenue

$= \left(x + y + \dfrac{xy}{100}\right)\% = \left(-10 + 10 - \dfrac{10 \times 10}{100}\right)\%$

[Here $x = -10$ and $y = 10$]

$= -1\%$.

$\therefore$ The revenue decreases by 1%

**44.** **(a)** Since $4\pi$ × radius × radius = surface area

$\therefore$ Net % change in area = $\left(x + y + \dfrac{xy}{100}\right)\%$

$= \left(10 + 10 + \dfrac{10 \times 10}{100}\right)\% = 21\%$

**45.** **(b)** We have, receipts = price × sales.

$\therefore$ Net % change in receipts

$= \left(x + y + \dfrac{xy}{100}\right)\%$

$= \left(-15 + 35 - \dfrac{15 \times 35}{100}\right)\% = 14\dfrac{3}{4}\%$

**46.** **(b)** Since side × side = area

$\therefore$ Net % change in area

$= \left(x + y + \dfrac{xy}{100}\right)\%$

$= \left(30 + 30 + \dfrac{30 \times 30}{100}\right)\% = 69\%$

$\therefore$ The area is increased by 69%

**47.** **(a)** Since $side_1 \times side_2$ = area

$\therefore$ Net % change in area

$= \left(x + y + \dfrac{xy}{100}\right)\%$

$= \left(30 + 20 + \dfrac{30 \times 20}{100}\right)\%$ [Here, $x = 30$ and $y = 20$]

= 56%

$\therefore$ The area of the rectangle so formed exceeds the area of the square by 56%

**48.** **(a)** Since $side_1 \times side_2$ = area

$\therefore$ Error % in area = $\left(x + y + \dfrac{xy}{100}\right)\%$

$= \left(10 - 20 - \dfrac{10 \times 20}{100}\right)\%$ [Here, $x = 10$ and $y = -20$]

= –12%, i.e., 12% deficit.

**49.** **(c)** Since side$_1$ × side$_2$ = area

$\therefore$ Net % change in area

$= \left(x + y + \frac{xy}{100}\right)\%$

$= \left(10 + 20 + \frac{10 \times 20}{100}\right)\%$

$= 32\%$

$\therefore$ The area of the rectangle increases by 32%.

**50.** **(a)** Since tax × consumption = expenditure

$\therefore$ Net % change in expenditure

$= \left(x + y + \frac{xy}{100}\right)\%$

$= \left(20 - 20 - \frac{20 \times 20}{100}\right)\%$ [Here, $x$ = 20 and $y$ = –20]

$= -4\%$

$\therefore$ Expenditure decreases by 4%

**51.** **(a)** Net % change in revenue

$= \left(x + y + \frac{xy}{100}\right)\%$

$= \left(-30 + 20 \frac{30 \times 20}{100}\right)\%$

[Here, $x$ = –30 and $y$ = 20]

$= -16\%$

**52.** **(b)** We have, $P$ = 90.51, $r$ = 10 and $n$ = 3.

$\therefore$ The population 3 years ago

$= \frac{P}{\left(1 + \frac{r}{100}\right)^n} = \frac{90 \cdot 51}{\left(1 + \frac{10}{100}\right)^3}$

$= \frac{9051}{100} \times \frac{100}{110} \times \frac{100}{110} \times \frac{100}{110}$

= 68 Lakhs.

**53.** **(c)** Here, $P$ = 8748, $r$ = –10 and $n$ = 3.

$\therefore$ Purchase price of the machine

$= \frac{P}{\left(1 + \frac{r}{100}\right)^n} = \frac{8748}{\left(1 - \frac{10}{100}\right)^3}$

$= \frac{8748 \times 100 \times 100 \times 100}{90 \times 90 \times 90}$ = ₹12000.

**54.** **(c)** Here, $P$ = 2664000, $r$ = 20 and $n$ = 2.

$\therefore$ Company's income in the year 1997

$= \frac{P}{\left(1 + \frac{r}{100}\right)^n} = \frac{2664000}{\left(1 + \frac{20}{100}\right)^2}$

$= \frac{2664000 \times 5 \times 5}{6 \times 6}$

= ₹1850000.

**55.** **(b)** Here, $P$ = 32000, $r$ = 15 and $n$ = 2.

$\therefore$ Population of the town in 2 years

$= P\left(1 + \frac{r}{100}\right)^n = 32000\left(1 + \frac{15}{100}\right)^2$

$= 32000 \times \frac{115}{100} \times \frac{115}{100} = 42320.$

**56.** **(c)** Here, $A$ = 6250, $x$ = –10, $y$ = –20 and $z$ = –30.

$\therefore$ Value of the machine after 3 years

$= A\left(1 + \frac{x}{100}\right)\left(1 + \frac{y}{100}\right)\left(1 + \frac{z}{100}\right)$

$= 6250\left(1 - \frac{10}{100}\right)\left(1 - \frac{20}{100}\right)\left(1 - \frac{30}{100}\right)$

$= \frac{6250 \times 90 \times 80 \times 70}{100 \times 100 \times 100}$ = ₹3150.

**57.** **(c)** Here, $A$ = 50400, $x$ = 12 and $y$ = –10.

$\therefore$ Population of the town 2 years ago

$= \frac{A}{\left(1 + \frac{x}{100}\right)\left(1 + \frac{y}{100}\right)}$

$= \frac{50400}{\left(1 + \frac{12}{100}\right)\left(1 - \frac{10}{100}\right)}$

$= \frac{50400 \times 100 \times 100}{112 \times 90}$

= 50000.

**58.** **(b)** Let ₹$A$ be the pocket money.

Then, $A\left(1 + \frac{x}{100}\right)\left(1 + \frac{y}{100}\right) = 480$ (Given)

Here, $x$ = –20 and $y$ = –25.

$\therefore A\left(1 - \frac{20}{100}\right)\left(1 - \frac{25}{100}\right) = 480$

$\Rightarrow A = \frac{480 \times 100 \times 100}{80 \times 75}$ = ₹800.

**59.** **(a)** Let $A$ be the original strength.

Then, $A\left(1 + \frac{x}{100}\right)\left(1 + \frac{y}{100}\right)\left(1 + \frac{z}{100}\right) = 729000$ (Given)

Here, $x$ = –10, $y$ = –10 and $z$ = –10.

$\therefore A\left(1 - \frac{10}{100}\right)\left(1 - \frac{10}{100}\right)\left(1 - \frac{10}{100}\right) = 729000$

$\Rightarrow A = \frac{729000 \times 100 \times 100 \times 100}{90 \times 90 \times 90}$ = 1000000 men.

**60.** **(b)** Let the daily wage before the increase was ₹$A$.

Then, $A\left(1 + \frac{x}{100}\right) = 25$. Here, $x$ = 25.

$\therefore A\left(1 + \frac{25}{100}\right) = 25 \Rightarrow A = \frac{25 \times 100}{125}$ = ₹20.

**61.** **(b)** Here, $x = 15$, $y = 80$ and $z = 70$.

$\therefore$ Maximum marks $= \frac{100(y+z)}{x} = \frac{100(80+70)}{15}$
$= 1000.$

**62.** **(c)** Percentage of students passing the examination
$= (100 - (30 + 35 - 27))\%$
[Here, $x = 30$, $y = 35$ and $z = 27$]
$= 62(100 - 38)\% = 62\%$

Let the total number of students appearing in the examination be $x$.

Given: 62% of $x = 248$

or, $\frac{62}{100} \times x = 248$ or $x = \frac{248 \times 100}{62} = 400.$

Therefore, 400 students appeared in the examination.

**63.** **(b)** Let the monthly rent be ₹$x$.

We have, 5.5% of 100000 = $x$ – 12.5% of $x$ – 325

$\Rightarrow \frac{5500}{12} = x - \frac{x}{8} - \frac{325}{12}$

$\Rightarrow \frac{5500}{12} + \frac{325}{12} = \frac{7}{8} \times x$

$\Rightarrow x = \frac{5825}{12} \times \frac{8}{7}$ = ₹554.76 per month.

**64.** **(b)** Boys = 900, Girls = 1100

Passed = (32% of 900) + (38% of 1100)
= 288 + 418 = 706

Failed = 2000 – 706 = 1294

Failed % $= \left(\frac{1294}{2000} \times 100\right)\% = 64.7\%$

**65.** **(a)** Suppose that his salary = ₹100

House rent = ₹10, balance = ₹90

Expenditure on education = ₹$\left(\frac{15}{100} \times 90\right)$
= ₹13.50

Balance = ₹76.50.

Expenditure on clothes = ₹$\left(\frac{10}{100} \times 76 \cdot 50\right)$
= ₹7.65

Balance now = ₹68.85

If balance is ₹68.85, salary = ₹100

If balance is ₹1377, salary = ₹ $\frac{100}{68 \cdot 85} \times 1377$
= ₹2000.

**66.** **(b)** Reduction $= \frac{30}{100+30} \times 100\% = 23\frac{1}{13}\%$

**67.** **(a)** 90% of original price can buy = 18 quintals

$\therefore$ He can buy $\frac{18 \times 100}{90}$ = 20 quintals at the lower price.

**68.** **(a)** Number of candidates who failed
= 40% of 1000 + 60% of 800
= 400 + 480
= 880

$\therefore$ Fail % $= \left(\frac{880}{1800} \times 100\right)\% = 48.88\%$

**69.** **(c)** New price must be increased by

$\left(\frac{20}{100-20} \times 100\right)\% = 25\%.$

**70.** **(a)** Let the fraction be $\frac{x}{y}$

Then, $\frac{x + 0.25x}{y - 0.10y} = \frac{5}{9}$ $\quad \frac{x(1.25)}{y(0.9)} = \frac{5}{9}$

$\frac{x}{y} = \frac{5}{9} \times \frac{90}{125}$ $\quad \frac{x}{y} = \frac{2}{5}.$

**71.** **(a)** Let the side of the square = $x$

After increase, length of one side = $1.3x$

Let after decrease, length of other side = $y$

Then, $(1.3x)(y) = x^2$

$y = \frac{10x}{13}$

Decrease in other side $= x - \frac{10x}{13} = \frac{3x}{13}$

Percentage decrease in other side

$= \frac{\frac{3x}{13}}{x} \times 100 = \frac{300}{13} = 23\frac{1}{13}\%$

## Exercise-2
## (Based on Memory)

**1.** **(c)** 75% of 40 + $x$% of 35 = 80% of 75

$\Rightarrow$ 30 + $x$% of 35 = 60 $\quad \Rightarrow$ $x$% of 35 = 30

$\therefore x = \frac{30 \times 100}{35} = 85.71\% \approx 86\%$

**2.** **(c)** Suppose original fraction $= \frac{x}{y}$

Then, $\frac{3x}{2.5y} = \frac{9}{10}$ $\quad \therefore \frac{x}{y} = \frac{3}{4}$

**3. (b)** Share of each daughter
= ₹1.25 Lakhs

$\therefore$ Share of grand child $= \frac{1}{10} \times 1.25$
$= 0.125$ Lakh

And share of each son $= 0.125 \times 8$
= ₹1 Lakh

$\therefore$ Money received by three sons and two daughters
$= 3 \times 1 + 2 \times 1.25$
= ₹5.5 Lakhs

$\therefore$ Money received by his wife

$= \frac{40}{100} \times 5.5$ ₹2.2 Lakhs

$\therefore$ Money received by his wife and three grandchildren
$= 2.2 + 3 \times 0.125$
= ₹2575000

**4. (e)** The original fraction

$$= \frac{\frac{4}{140} \times 100}{\frac{15}{150} \times 100} = \frac{4}{140} \times \frac{150}{15} = \frac{2}{7}$$

$$\begin{array}{ccc} 80\% & & ? \\ & 60\% & \\ 1 & & 1 \end{array}$$

Here, $= \frac{80 \times 1 + ? \times 1}{1+1}$

$\therefore$ ? = 60 ×2 –80 × 1 = 40

**6. (d)** $\frac{43}{100} \times 2750 - \frac{38}{100 \times 2990} = 1182.5 - 1136.2 = 46.3$

**7. (d)** We have, 7% of Sujata's monthly salary = ₹2170
(7 + 18 + 6)% of Sujata's monthly salary

$\frac{2170}{7} \times 31 =$ ₹9610

Thus, total annual amount invested by Sujata
= 9610 × 12 = 1,15,320

**8. (a)** Go through the given options.

$$\frac{10 \times \frac{350}{100}}{10 \times \frac{500}{100}} = \frac{10 \times 35}{19 \times 50} = \frac{7}{19}$$

**9. (b)** Number of sweets = 20% of 65 × 65
= 13 × 65 = 845.

**10. (a)** $\frac{x+2x}{y+3y} = \frac{6}{11} \Rightarrow \frac{3x}{4y} = \frac{6}{11} \quad \therefore \quad \frac{x}{y} = \frac{6 \times 4}{11 \times 3} = \frac{8}{11}$

**11. (c)** 75% of toal amount
= 55,475 + 28525 = 84000

Total amount = $84000\left(\frac{4}{3}\right) =$ ₹1,12,000

**12. (a)** 12% of monthly salary = ₹3660

$\therefore$ 31% of monthly salary = ₹3660 $\left(\frac{31}{12}\right)$
= ₹9455

$\therefore$ Annual investment = 12 × 9455
= ₹1,13,460

**13. (a)** 40% of the number = 380
$\therefore$ 20% the of number = 190

**14. (b)** Required % $= \frac{700}{5600} \times 100 = \frac{100}{8} = 12.5$

**15. (b)** Total number of sweets
= (50% of 90) (20% of 90) + (50% of 90) (10% of 90)
= (45 × 18) + (45 × 9) = 45 × 27 = 1215

**16. (b)** 15% of salary = ₹4,428

$\therefore$ 42% of salary $= \frac{4428}{15} \times 42 =$ ₹12,398.4

**17. (e)** Suppose the third number is 100.
Then first no. = 50 and second no. = 46

$\therefore$ requirded % $= \frac{50-46}{50} \times 100 = 8$

**18. (c)** Total valid votes
= 75% of 8400 = 6300
Votes got by the other person
= 48% of 6300 = 3024

**19. (e)** Ratio of shares of A, B and C
= 75:60:80
= 15:12:16

Now, the share of C $= \frac{16}{(15+12+16)} \times 731$

$= \frac{16}{43} \times 731 =$ ₹272

**20. (a)** Go through the given options. Check the options a

$\frac{4+6}{9+27} = \frac{10}{36} = \frac{5}{18}$

**21. (d)** Required value

$= \frac{25}{100} \times \frac{30}{100} \times \frac{2}{5} \times 2000$
= 60

**22. (b)** Vipul's salary

$= 1687.50 \times \frac{100}{75} \times \frac{100}{5} = 45,000$

**23.** **(c)** (40% – 25%) of $x$ = 198

$\Rightarrow$ 12% of $x$ = 198

$\therefore$ 64% of $x = \frac{198}{12} \times 64$

= 66 × 16 = 1056

**24.** **(d)** 50% of ($x$ – $y$) = 30% of ($x$ + $y$)

$\Rightarrow \frac{x-y}{2} = \frac{3(x+y)}{10}$

$\Rightarrow 5x - 5y = 3x + 3y$

$\Rightarrow 2x = 8y \Rightarrow x = 4y$

$\Rightarrow x = \frac{400}{100}y \Rightarrow$ 400% of $y$.

**25.** **(c)** 10% of $A$ = 15% of $B$

= 20% of $C$

$\Rightarrow \frac{A}{10} = \frac{3B}{20} = \frac{C}{5} = k$, say

$\Rightarrow A = 10k, B = \frac{20k}{3}, C = 5k$

Given $A + B + C = 7800$

$\Rightarrow 10k + \frac{20k}{3} + 5k = 7800$

$\Rightarrow 65k = 7800 \times 3 \Rightarrow k = 360$

$\therefore$ B's income = $\frac{20k}{3} = \frac{20 \times 360}{3}$

= 20 × 120 = ₹2400

**26.** **(d)** $x = y$ – 10% $y$

$y$ = 125 + 10% of 125

= 125 + 12.5 = 137.5

$\therefore$ $x$ = 137.5 – 10% of 137.5

= 137.5 – 13.75 = 123.75

**27.** **(a)** (100 + 20)% = 120%

$\left(120 - 120 \times \frac{20}{100}\right)\% = 96\%$

**29.** **(e)** Income of company in 1997

$= \frac{2664000}{\left(1 + \frac{20}{100}\right)^2}$

$= 2664000 \times \frac{25}{36} =$ ₹1850000.

**30.** **(c)** Let the investment of $X$ in 1995 be ₹$x$

$\therefore$ Profit = ₹ $\frac{x}{5}$ $\therefore$ Income = ₹ $\left(x + \frac{x}{5}\right)$ = ₹ $\frac{6x}{5}$

Investment of company $X$ in 1996 would be ($x$ – 5000)

From the question,

$(x - 5000) \times \frac{126}{100} = \frac{6}{5}x \Rightarrow x =$ ₹105000.

**31.** **(a)** Suppose the production of the company in the year 1990 be $x$

Then, production of the company in year 1994

$= x \times \frac{115}{100} \times \frac{115}{100} \times \frac{90}{100} \times \frac{115}{100} = 1.368x$

$\therefore$ Increase % in the production in year 1994

$= \frac{(1.368x - x) \times 100}{x} = 36.8\% \approx 37\%.$

**32.** **(c)** ? % of 700 = 500 – 125% of 260

? % of 700 = 500 – $\frac{125}{100} \times 260$

$\therefore$ ? = $\frac{175 \times 100}{700}$ = 25.

**33.** **(b)** 45% of 750 – 25% of 480

$= \frac{45}{100} \times 750 - \frac{25}{100} \times 480$

= 337.50 – 120 = 217.5.

**34.** **(d)** Suppose the first number is $x$ and the second number is $y$

Therefore, 40% of $x = \frac{2}{3}$ of $y$

$\therefore \frac{x}{y} = \frac{2}{3} \times \frac{100}{40} = \frac{5}{3}.$

**35.** **(c)** Let the printed price be ₹$x$

Discount = 20%

$\therefore$ SP = $\frac{4x}{5}$

Profit = 15%

$\therefore$ CP = $\frac{100 \times \frac{4x}{5}}{100 + 15} = \frac{80x}{115} = \frac{16x}{23}$

$\therefore \frac{\text{CP}}{\text{Printed Price}} = \frac{16}{23}.$

**36.** **(d)** $-20 - 15 + \frac{(-20) \times (-15)}{100} = -35 + 3 = -32$

$\therefore$ Two successive discounts of 20% and 15% are equivalent to a single discount of 32%

**37.** **(c)** Let the second discount be $x$%

$\therefore$ 800 – 10% = 720

720 – $x$% of 720 = 612

$\Rightarrow \frac{x}{100} \times 720 = 108$

$\Rightarrow x = \frac{108 \times 100}{720} = 15.$

**38.** **(a)** 5% of (5% of 100) = 5% of 5

$= \frac{1}{4} = 0.25.$

**39.** **(d)** Let the original bill was for ₹$x$

$\therefore$ $x$ – 20% of $x$ = 100

$\Rightarrow$ $\dfrac{4x}{5}$ = 100 $\Rightarrow$ $x$ = 125.

**40.** **(b)** $x$% of $y$ = 100, $y$% of $z$ = 200

$\Rightarrow$ $xy$ = 10000, $yz$ = 20000

$\Rightarrow$ $\dfrac{xy}{yz} = \dfrac{10000}{20000} = \dfrac{1}{2}$

$\Rightarrow$ $z = 2x$.

**41.** **(c)** Let the numbe₹be $x$ and $y$

$\therefore$ $x + y = 150$

40% of $x$ = 60% of $y$

$\Rightarrow$ $2x = 3y$

$\therefore$ $\dfrac{3y}{2} + y = 150 \Rightarrow 5y = 300 \Rightarrow y = 60$

$\Rightarrow x = 90$

Hence, the greater number = 90.

**42.** **(b)** Let the numbe₹be $x$, $y$ and $z$

$\therefore$ $x = z$ – 30% of $z$ = $\dfrac{7z}{10}$

$y = z$ – 37% of $z$ = $\dfrac{63z}{100}$

$\Rightarrow$ $\dfrac{10x}{7} = \dfrac{100y}{63} \Rightarrow x = \dfrac{10y}{9}$

$\Rightarrow$ $y = \dfrac{9x}{10} = x - \dfrac{x}{10}$

$\Rightarrow$ $y = x$ – 10% of $x$.

**43.** **(d)** 8% votes are invalid.

Winner got 48% of the total votes.

Loser will get

100 – (8 + 48) = 44% of the total votes

Now, the total number of vote₹in the election

= $\dfrac{1100}{4}$ × 100 = 27500.

**44.** **(c)** Population of a city after 2 years

= $180000\left(1+\dfrac{10}{100}\right)^2$ = 217800.

**45.** **(b)** Reduced Price = $\dfrac{20\% \text{ of } 100}{4}$ = ₹5 per Kg.

**46.** **(c)** 60% of A = 75% of B or, $\dfrac{3A}{5} = \dfrac{3B}{4}$

$\Rightarrow$ $\dfrac{A}{B} = \dfrac{5}{4}$

Now, B = $x$% of A

or, $x = \dfrac{B}{A}$ × 100 = $\dfrac{5}{4}$ × 100 = 80%.

**47.** **(a)** Marked price of the article

= $\dfrac{387}{100-14}$ × 100 = ₹450.

**48.** **(b)** Let the CP of the article be ₹100, then MP of the article = ₹110

If the trader has a loss of 1%, it means that the trader sold the article at ₹99

$\therefore$ % discount = $\dfrac{110-99}{110}$ × 100 = 10%

**49.** **(b)** CP of cycle = 1100 × $\dfrac{90}{100} \times \dfrac{100}{110}$ = ₹900.

**50.** **(a)** Profit % = +20 – 5 – $\dfrac{20 \times 5}{100}$ = 15 – 1 = 14%

**51.** **(d)** Let the income = ₹$x$

Given: $\dfrac{90}{100} \times \dfrac{70}{100} \times \dfrac{80}{100} x = 10080$

$\Rightarrow$ $504x = 10080000$ or, $x$ = ₹20000.

**52.** **(d)** Number of failure students

= 40% of 640 + 20% of 360 = 256 + 72 = 328

% of failure = $\dfrac{328}{1000}$ × 100 = 32.80%

**54.** **(d)** Let the original price of rice per Kg be ₹$x$

Now, $\dfrac{385}{4x/5} - \dfrac{385}{x} = 3.5$ or, $x$ = ₹27.50.

**55.** **(b)** Ratio of two numbers = $\dfrac{13}{2}\% : \dfrac{17}{2}\%$ = 13:17

Smaller number = $\dfrac{13}{4}$ × 1660 = 5395.

**56.** **(b)** Two successive discounts of 10%

= –10 – 10 + $\dfrac{(-10)\times(-10)}{100}$ = –19%

So, resultant = +30 – 19 + $\dfrac{30 \times (-19)}{100}$ = +5.3%

**57.** **(c)** Let CP of one article be ₹$x$

$\therefore$ CP of 16 articles = ₹16$x$

SP of 16 articles = ₹$16x\left(\dfrac{135}{100}\right)$

Let the marked price of the article be increased by $y$% above the cost price.

Then, $15x\left(\dfrac{100+y}{100}\right) \times \left(\dfrac{96}{100}\right) = 16x\left(\dfrac{135}{100}\right)$

or, $(100 + y)6 = 900$

or, $y = 150$

i.e., M.P. of the article is 50% above the cost price.

**58.** **(b)** Salary = $\dfrac{1500}{20}$ × 100 = ₹7500.

**59.** **(e)** Each student got sweets $= \dfrac{20}{100} \times 35 = 7$ sweets

35 students got sweets = 35 × 7 sweets

Each teacher got sweets $= \dfrac{40}{10} \times 35 = 14$

6 teachers got sweets = 6 × 14 = 84

Total sweets = 245 + 84 = 329

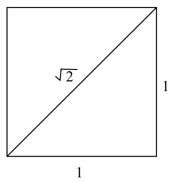
**60. (d)** Let 100 angstroms $= x\%$ of 10 microns

$\Rightarrow$ 100 angstroms $= x\%$ of 100000 angstroms

$$\Rightarrow x = \frac{100 \times 100}{100000} = \frac{1}{10} = 0.1.$$

**61. (a)** Suppose side of the square = 1 metre

$\therefore$ Diagonal $= \sqrt{2}$ m




Distance saved by not walking along the edges

$= 2 - \sqrt{2}$

i.e., $\left(\frac{2-\sqrt{2}}{2} \times 100\right)\%$ i.e., 29.3% ≈ 30%.

**62. (a)** $$\frac{ptd}{(t + 20\% \text{ of } t)\left(p - \frac{p}{3}\right)} = \frac{ptd}{\frac{6t}{5} \times \frac{2p}{3}} = \frac{5}{4}d.$$

**63. (c)** 120 coats for full length. 500 shorter length coats are removed.

$\therefore$ Percentage of full length coats out of the remaining 300 coats

$$= \frac{120}{300} \times 100 = 40.$$

**64. (b)** $S$ = 150% of $T$

$$\Rightarrow S = \frac{150T}{100}$$

$$\Rightarrow S = \frac{3}{2}T$$

$$\Rightarrow S + T = \frac{3}{2}T + T = \frac{5T}{2}$$

$$\Rightarrow T = \frac{2}{5}(S + T)$$

$= 40\%$ of $(S + T)$.

**65. (b)** Suppose total number of students = 100

$\therefore$ No. of seniors who attended the play = 20

Total number of students who attended the play = 60

$\therefore$ No. of non-seniors who attended the play

= 60 – 20 = 40 i.e., 40%

**66. (d)** Effective increase percentage

$$= \left(10 + 20 + \frac{20 \times 10}{100}\right)\% = 32$$

Therefore, $x \times \frac{132}{100} = 33$

$$\Rightarrow x = \frac{32 \times 100}{132} = ₹25$$

**67. (c)** Let the amount of the bill be ₹$x$

Therefore, $\frac{4x}{100} = 13$

$4x = 1300$

$$\Rightarrow x = \frac{1300}{4} = ₹325$$

**68. (d)** Houses containing only one person

= 100 – 40 = 60%

Houses containing only a male

$$= 60 \times \frac{25}{100} = 15\%$$

$\therefore$ Houses containing only one female

= 60 – 15 = 45%.

**69. (b)** Let the original cost price of sugar be ₹$x$ per Kg.

$$\Theta \quad \frac{270 \times 100}{90x} - \frac{270}{x} = 1$$

$$\frac{270}{x}\left(\frac{10}{9} - 1\right) = 1$$

$$\Rightarrow \frac{30}{x} = 1$$

$\therefore$ $x$ = ₹30 per Kg

**70. (d)** Let the third number be 100

Then, first number = 70

Therefore, second number = 63

Hence, required % $= \frac{70 - 63}{70} \times 100$

$$= \frac{7}{70} \times 100 = 10\%$$

**71. (d)** Required effect $= \left(+40 - 40 - \frac{40 \times 40}{100}\right)\%$

$= -16\%$.

i.e., the area will decrease by 16%.

**72. (a)** In 1 Kg mixture quantity of iron = 20 gm

Let $x$ gm sand should be added, then 10% of $(1000 + x) = 200$

$\therefore$ $x$ = 1000 gm = 1 Kg.

**73. (b)** Increase % $= \frac{7.50 - 6 \times 100}{6} = 25$

Therefore, decrease percentage in consumption

$$= \frac{25}{125} \times 100 = 20\%$$

**74.** **(a)** $\frac{a}{b} = \frac{5}{4}$, $b = \frac{4}{5}a$ (Given)

Given: (40% of $a$) = $\frac{2}{5}a = 12$

$\therefore$ $a = 5 \times 6$ and $b = \frac{4}{5} \times 5 \times 6 = 24$

$\therefore$ 50% of $b = \frac{24}{2} = 12$.

**75.** **(b)** Let the first and the second number be $x$ and $y$, respectively, then

$y$ + 30% of $x$ = 140% of $y$

or, $y + 0.3x = 1.4y$

or, $0.3x = 0.4y$

$\therefore$ $x{:}y = 4{:}3$

**76.** **(a)** Suresh = Vinod + 30% of Vinod
= 1.3 Vinod
Vinod = Vinay – 20% of Vinay
= 80% of Vinay
= 0.8 Vinay

$\therefore$ Suresh = 1.3 × 0.8 Vinay
= 1.04 Vinay

Now,
Suresh – Vinay = 1.04 Vinay – Vinay
= 0.04 Vinay
= ₹800 (given)

$\therefore$ Vinay = ₹20000

$\therefore$ Vinod = 0.8 × 20000 = ₹16000.

**77.** **(a)** Let the first and second numbers be $x$ and $y$, respectively.

$$y - x \times \frac{25}{100} = y \times \frac{5}{6}$$

or, $y - \frac{x}{4} = \frac{5}{6}y$ or, $\frac{1}{6}y = \frac{x}{4}$

$\therefore$ $x{:}y = 2{:}3$.

**78.** **(a)** In 1 l mixture quantity of unleaded petrol = 100 ml
Let $x$ ml leaded petrol be added, then 5% of $(1000 + x)$ = 100 ml

or, $5(1000 + x) = 100 \times 100$

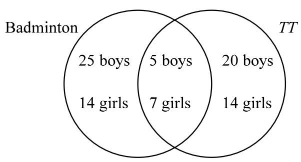
$x = \frac{5000}{5} = 1000$ ml.

**79.** **(b)** Let the number of boys = $x$

Then, $x + \frac{7x}{10} = 85$

$\Rightarrow$ $x = 50$

No. of girls = 85 – 50 = 35.




**80.** **(d)** Let the original fraction be $\frac{x}{y}$

Then, $\frac{x+2}{y+1} = \frac{5}{8}$ or, $8x - 5y = -11$ $\cdots(1)$

Again, $\frac{x+3}{y+1} = \frac{3}{4}$ or, $4x - 3y = -9$ $\cdots(2)$

Solving, we get $x = 3$ and $y = 7$

$\therefore$ Fraction = $\frac{3}{7}$

**81.** **(c)** Let the numbers be $y$ and $x$, respectively.

$x$ + 50% of $y = \frac{4x}{3}$ or, $\frac{y}{2} = \frac{4x}{3} - x$

or, $\frac{y}{2} = \frac{x}{3}$ or, $\frac{y}{x} = \frac{2}{3}$.

**82.** **(a)** Let the total marks of the exam be $x$.
Then,

$$x \times \frac{54}{100} = 456 - 24$$

$$\Rightarrow \quad x \times \frac{54}{100} = 432$$

$$\Rightarrow \quad x \times \frac{432 \times 100}{54} = 800$$

$\therefore$ Minimum passing marks

$$= 800 \times \frac{34}{100}$$
$$= 272$$

Hence, required more marks get by Raman
= 456 – 272
= 184

**83.** **(c)** Successive discounts = $20\% + \frac{20 \times 80}{100}$
= 20 + 16 = 36%

Difference in discounts = 36 – 35 = 1%

$\therefore$ Bill amount = 22 × 100
= ₹2200.

**84.** **(c)** $D = \frac{2}{5}R$ $\quad S = \frac{1}{4} \times \frac{2}{5}R = \frac{1}{10}R$

and, $\frac{1}{10}R - 200 = 600$

$\therefore$ $\frac{1}{10}R = 800$

$\therefore$ $R$ = ₹8000

**85.** **(a)** CP of the article = $960 \times \frac{100}{120}$ = ₹800

$\therefore$ C.P. of 5 articles = ₹800 × 5 = ₹4000

$\therefore$ S.P. of 5 articles = ₹825 × 5 = ₹4125

$\therefore$ Gain % = $\frac{4125 - 4000}{4000} \times 100 = 3.125\%$

**86.** **(b)** Suppose there are $8x$ questions apart from 41 questions. Then,

$$\frac{37+5x}{41+8x} = 80\% = \frac{4}{5}$$

$\Rightarrow$ $185 + 25x = 164 + 32x$

$\Rightarrow$ $7x = 21 \Rightarrow x = 3$

$\therefore$ Total number of questions $= 41 + 8x$

$= 41 + 8 \times 3$

$= 41 + 24 = 65.$

**87.** **(a)** Number of students who speak only English

$= 30\%$ of $60 = 18$

Number of students who speak Hindi and English

$= 20\%$ of $60 = 12$

$\therefore$ Number of students who speak only Hindi

$= (60 - 30) = 30$

$\therefore$ Number of students who speak Hindi

$= 30 + 12 = 42.$

**88.** **(b)** Number of females $= 156800 \times \dfrac{100}{80} = 196000$

$\therefore$ Number of males $= \dfrac{7}{8} \times 196000 = 171500$

$\therefore$ Total population $= 196000 + 171500 = 367500.$

**89.** **(c)** Let the investment of $X$ in 1995 be ₹$x$

$\therefore$ Profit = ₹$\dfrac{x}{5}$ $\quad\therefore$ Income = ₹$\left(x+\dfrac{x}{5}\right)$ = ₹$\dfrac{6x}{5}$

Investment of company $X$ in 1996 would be $(x - 5000)$

From the question,

$(x - 5000) \times \dfrac{126}{100} = \dfrac{6}{5}x \Rightarrow x =$ ₹105000.

**90.** **(a)** Suppose the production of the company in the year 1990 be $x$

Then, production of the company in year 1994

$$= x \times \frac{115}{100}\times\frac{115}{100}\times\frac{90}{100}\times\frac{115}{100}$$

$= 1.368x$

$\therefore$ Increase % in the production in year 1994

$$= \frac{(1.368x - x)\times 100}{x}$$

$= 36.8\%$

$\approx 37\%.$

**91.** **(d)** $\Theta$ Maximum marks in examination $= 875$

$\therefore$ Ritu's marks $= 875 \times \dfrac{56}{100} = 490$

and Smita's marks $= 875 \times \dfrac{92}{100} = 805$

and Rina's marks $= 634$

Hence, required average marks

$$= \frac{490+805+634}{3} = \frac{1929}{3} = 643$$

**92.** **(c)** $\because$ Candidate secured 336 marks in 700 total marks

$\therefore$ Candidate secured 468 marks in $\dfrac{700}{336} \times 468$

$= 975$ total marks.

**93.** **(c)** Let the second discount be $x\%$

$\therefore$ $800 - 10\% = 720$

$720 - x\%$ of $720 = 612$

$\Rightarrow$ $\dfrac{x}{100} \times 720 = 108$

$\Rightarrow$ $x = \dfrac{108\times 100}{720} = 15.$

**94.** **(d)** $\because$ Total number of employees $= 4800$

$\therefore$ Males people $= 4800 \times \dfrac{45}{100} = 2160$

Hence, number of people, younger than 25 year

$= 2160 \times \dfrac{40}{100} = 864$

**95.** **(d)** $\because$ Third number $= 2400$

$\therefore$ Second number $= \dfrac{1}{4} \times 2400 = 600$

and first number $\times \dfrac{6}{11} = 22\%$ of $600$

$\Rightarrow$ First number $= \dfrac{11}{6} \times 600 \times \dfrac{22}{100}$

$= 242$

Hence, 45 of the first number $= \dfrac{242\times 45}{100} = 108.90$

**96.** **(b)** Suppose the salary of Bhawna was ₹$x$.

$$\left(\frac{12}{100}\text{ of } x\right)\times\frac{125}{100} = 2400$$

$$x\times\frac{12}{100}\times\frac{125}{100} = 2400$$

$$x = \frac{2400\times 100\times 100}{12\times 125}$$

= ₹16000

**97.** **(d)** Suppose the original fraction is $\dfrac{x}{y}$.

According to question,

$$\frac{x + x\times\dfrac{400}{100}}{y + y\times\dfrac{500}{100}} = \frac{20}{27}$$

$\Rightarrow$ $\dfrac{x+4x}{y+5y} = \dfrac{20}{27}$

$\Rightarrow$ $\dfrac{5x}{6y} = \dfrac{20}{27}$

$\Rightarrow$ $\dfrac{x}{y} = \dfrac{20\times 6}{5\times 27}$

$\Rightarrow$ $\dfrac{x}{y} = \dfrac{8}{9}$

**98.** **(b)** Let the numbers be $x$, $y$ and $z$

$\therefore \quad x = z - 30\% \text{ of } z = \dfrac{7z}{10}$

$y = z - 37\% \text{ of } z = \dfrac{63z}{100}$

$\Rightarrow \quad \dfrac{10x}{7} = \dfrac{100y}{63} \Rightarrow x = \dfrac{10y}{9}$

$\Rightarrow \quad y = \dfrac{9x}{10} = x - \dfrac{x}{10}$

$\Rightarrow \quad y = x - 10\% \text{ of } x.$

**99.** **(d)** 8% votes are invalid.

Winner got 48% of the total votes.

Loser will get

100 – (8 + 48) = 44% of the total votes

Now, the total number of voters in the election

$= \dfrac{1100}{4} \times 100 = 27500.$

**100.** **(c)** Suppose maximum marks = $x$

Then, $x \times \dfrac{35}{100} = 40 + 30$

$\Rightarrow \quad x \times \dfrac{35}{100} = 70 \Rightarrow x = \dfrac{70 \times 100}{35}$

$x = 200$ marks

**101.** **(d)** According to passing percentage = 40% (boys)

According to question,

$x \times 40\% = 483 + 117$ (If total marks = $x$)

$x \times \dfrac{40}{100} = 600$

$x = \dfrac{600 \times 100}{40}$

$x = 1500$

Passing marks for girls = $1500 \times \dfrac{35}{100} = 525$

**102.** **(b)** Let the C.P. of the article be ₹100, then M.P. of the article = ₹110

If the trader has a loss of 1%, it means that the trader sold the article at ₹99

$\therefore$ % discount = $\dfrac{110 - 99}{110} \times 100 = 10\%.$

**103.** **(d)** Let the income = ₹$x$

Given,

$\dfrac{90}{100} \times \dfrac{70}{100} \times \dfrac{80}{100} x = 10080$

$\Rightarrow \quad 504x = 10080000$

or, $\quad x =$ ₹20000.

**104** **(d)** Let the original price of rice per Kg be ₹$x$

Now, $\dfrac{385}{4x/5} - \dfrac{385}{x} = 3.5$ or $x =$ ₹27.50.

**105.** **(b)** Two successive discounts of 10%

$= -10 - 10 + \dfrac{(-10) \times (-10)}{100} = -19\%$

So, resultant $= +30 - 19 + \dfrac{30 \times (-19)}{100} = +5.3\%$

**106.** **(c)** Let C.P. of one article be ₹$x$

$\therefore$ C.P. of 16 articles = ₹$16x$

S.P. of 16 articles = ₹$16x\left(\dfrac{135}{100}\right)$

Let the marked price of the article be increased by $y$% above the cost price.

Then, $15x\left(\dfrac{100+y}{100}\right) \times \left(\dfrac{96}{100}\right) = 16x\left(\dfrac{135}{100}\right)$

or, $(100 + y)6 = 900$ or $y = 150$

i.e., M.P. of the article is 50% above the cost price.

**107.** **(a)** Let the number to be added be $x$.

Now, according to the question,

$\dfrac{320 \times 10}{100} + x = \dfrac{230 \times 30}{100}$

$\Rightarrow \quad 32 + x = 69$

$\Rightarrow \quad x = 69 - 32 = 37$

**108.** **(a)**

**Quicker Method:**

Increase in first year = 10%

Decrease in second year = 10%

Effective result

$$= \left(10 - 10 - \frac{10 \times 10}{100}\right)\% = -1\%$$

Increase in third year = 10%

$\therefore$ Effective result $= \left(10 - 1 - \dfrac{10 \times 1}{100}\right)\%$

= (9 – 0.1)% = 8.9% (increase)

**109.** **(b)** Present worth of bike $= P\left(1 - \dfrac{R}{100}\right)^T$

$= 62500\left(1 - \dfrac{4}{100}\right)^2 = 62500\left(1 - \dfrac{1}{25}\right)^2$

$= 62500\left(\dfrac{25-1}{25}\right)^2 = \dfrac{62500 \times 24 \times 24}{25 \times 25}$

= ₹57600

**110.** **(c)** Let the number be $x$.

Now, according to the question,

$$x \times \frac{245}{200} = 98 \quad \Rightarrow \quad x = \frac{98 \times 200}{245} = 80$$

**111.** **(b)** If $D$ gets 100 marks, then

Marks obtained by C = 125

Marks obtained by $\text{B} = \dfrac{125 \times 90}{100}$

Marks obtained by $A = \frac{125 \times 90}{100} \times \frac{125}{100}$

$\because \quad 100 \equiv \frac{125 \times 125 \times 90}{10000}$

$\therefore \quad 320 \equiv \frac{125 \times 125 \times 90 \times 320}{1000000} = 450.$

**112. (a)** Required percentage

$= \frac{40 \times 100 + 50 \times 90 + 60 \times 80}{40 + 50 + 60} = 88\frac{2}{3}\%$

**113. (d)** Salary of the clerk in

$1974 = \frac{3660 \times 100}{120} = ₹3050$

**114. (d)** Total percentage of expenditure

$= \left(20 + \frac{80 \times 70}{100}\right)\% = 76\%$

Let the total income be ₹$x$.

Now, according to the question,

$x \times \frac{24}{100} = 1800 \quad \Rightarrow \quad x = \frac{1800 \times 100}{24} = ₹7500$

**115. (a)** Let Rama's expenditure be ₹$3x$ and Savings be ₹$2x$.

New income $= \frac{5x \times 110}{100} = ₹\frac{11x}{2}$

Expenditure $= \frac{3x \times 112}{100} = ₹\frac{336x}{100}$

$\therefore$ Savings $= \frac{11x}{2} - \frac{336x}{100}$

$= \frac{550x - 336x}{100} = ₹\frac{214}{100}x$

Increase in savings $= \frac{214x}{100} - 2x = \frac{14x}{100}$

$\therefore$ Percentage increase $= \frac{14x}{200x} \times 100 = 7\%$

**116. (c)** The original fraction

$= \frac{25}{51} \times \frac{(350 + 100)}{150 + 100} = \frac{25}{51} \times \frac{45}{25} = \frac{15}{17}$

**117. (d)** Third number = 100

First number = 130

Second number = 140

Now, according to the question,

$\frac{130}{140} \times 100 = x \quad \Rightarrow \quad x = \frac{650}{7} = 92\frac{6}{7}$

**118. (b) Quicker Method:**

Percentage decrease $= \frac{r}{100 + r} \times 100\%$

$= \frac{25}{125} \times 100 = 20\%$

**119. (a)** Percentage of candidates who failed in one or two or both subjects = 52 + 42 – 17 = 77

$\therefore$ Percentage of passed candidates

=100 – 77 = 23

**120. (c)** Let the total number of votes polled be $x$

Now, according to the question,

$x \times \left(\frac{60 - 40}{100}\right) = 298$

$\Rightarrow \quad x \times \frac{1}{5} = 298$

$\Rightarrow x = 298 \times 5 = 1490$

**121. (c)** Let the red marbles be added be $x$.

Now, according to the question,

$\frac{10 + x}{40 + x} \times 100 = 60$

$\Rightarrow \quad \frac{(10 + x) \times 5}{40 + x} = 3$

$\Rightarrow \quad 50 + 5x = 120 + 3x$

$\Rightarrow \quad 5x - 3x = 120 - 50$

$\Rightarrow \quad 2x = 70 \quad \Rightarrow \quad x = \frac{70}{2} = 35$

**122. (a)** Let the number be $x$.

Now, according to the question,

$x \times \frac{x}{4} = x \times \frac{300}{100}$

$\Rightarrow \quad \frac{x^2}{4} = 3x \quad \Rightarrow \quad x = 3 \times 4 = 12$

**123. (b) Quicker Method:**

Required reduction per cent $= \frac{x}{100 + x} \times 100$

$= \frac{50}{150} \times 100 = \frac{50}{150} \times 100 = 33\frac{1}{3}\%$

**124. (a)** Increase in price = 20%

New price = ₹120

New sales = (100 − 15) = 85

Old sales = 100 × 100 = ₹10000

New sales = 120 × 85 = ₹10200

Effect $= \frac{200}{10000} \times 100\% = 2\%$ increase

**125.** **(c)** $\because$ 80% expenditure of ₹15000 salary = ₹12000

Savings = ₹(15000 − 12000) = ₹3000

After 20% price rise

$\Rightarrow$ Increased expenditure = 20% of ₹12000

= ₹2400

$\Rightarrow$ New Expenditure = ₹(12000 + 2400)

= ₹14400

$$\Rightarrow \text{New Income} = ₹\left(15000 \times \left(\frac{100+20}{100}\right)\right)$$

$$= \left(\frac{15000 \times 120}{100}\right) = ₹18000$$

$\therefore$ New savings = ₹(18000 − 14400)

= ₹3600

**126.** **(a)** Let the third number be $x$.

$$\text{First number} = x + \frac{12.5x}{100} = \frac{225x}{200}$$

$$\text{Second number} = x + \frac{25x}{100} = \frac{125x}{100} = \frac{250x}{200}$$

$$\text{Now, required percentage} = \frac{\frac{225x}{200}}{\frac{250x}{200}} \times 100\%$$

$$= \frac{225x}{250x} \times 100\% = 90\%$$

**127.** **(c)** Let the population of the town be 100 Population increase = 2.5%

$\therefore$ New population = 102.5

Now, according to the question, Population decreases by 0.5%

$$= \frac{102.5 \times 0.5}{100} = 0.5125$$

After one year, population = 102.5 − 0.5125 = 101.9875

$\therefore$ Total increase % = (101.9875 − 100) = 1.98%

Required percentage of increase in two years

$$= \left(101.98 + \frac{101.98 \times 1.98}{100}\right) - 100$$

= (101.98 + 2.019) −100

= 103.999 – 100

= 3.999% ≈ 4%

**128.** **(d)** Discount on one shirt $= ₹\frac{320 \times 25}{100} = ₹80$

Let, on buying $x$ shirts, the total discount = $80x$

$\therefore$ $80x = 400$ $\Rightarrow$ $x = 5$

$\therefore$He should purchase 5 shirts.

**129.** **(c)** **Quicker Method:**

$$\text{Required reduced price} = \frac{10}{100} \times \frac{22500}{25} = ₹90$$

**130.** **(d)** Let Ram's income be ₹100

$\Rightarrow$ Donation given to charity = ₹4

$\Rightarrow$ Remaining amount = ₹96

$\Rightarrow$ Again deposited amount in bank

$$= ₹\frac{96 \times 10}{100}$$

$\Rightarrow$ Amount left with him

$$= ₹\left(96 - \frac{96 \times 10}{100}\right) = ₹\,86.4$$

$\Rightarrow$ But he has actual amount = ₹8640

$$\therefore \text{ His real income } = ₹\left(\frac{8640}{86.4} \times 100\right)$$

= ₹10000

**131.** **(c)** $? = \frac{134 \times 3894}{100} + 38.94 \times 134$

=38.94 × 134 + 38.94 × 134

≈ 2 × (39 × 134) = 78 × 134=10452

**132.** **(e)** ? = 23% of 6783 + 57% of 8431

$$= \frac{23}{100} \times 6783 + \frac{57}{100} \times 8431$$

$$= 23 \times 67.83 + 57 \times 84.31$$

$$= 1560.09 + 4805.67 = 6365.76 \approx 6360$$

**133.** **(e)** Let the three consecutive numbers be $x$, $x$ + 1 and $x$ + 2.

Then, $x + x + 1 + x + 2 = 2262$

or, $3x = 2262 - 3 = 2259$

$$\therefore \quad x = \frac{2259}{3} = 753$$

$\therefore$ The numbers are 753, 754, 755.

The highest number is 755.

$$41\% \text{ of } 755 = \frac{41}{100} \times 755 = 41 \times 7.55 = 309.55$$

**134.** **(b)** Akash scored in subject A = 73 marks

$$\text{Subject B} = \frac{56 \times 150}{100} = 84 \text{ marks}$$

Total marks Akash got in all the three subjects together

$$= \frac{54}{100} \times 450 = 54 \times 4.5 = 243 \text{ marks}$$

Let Akash's marks in subject C be $x$.

$A + B + C = 243$

or, $A + B + x = 243$

or, $x = 243 - (84 + 73) = 243 - 157 = 86$ marks

**135. (c)** $40\times\frac{4330}{100}+59\times\frac{5000}{100}=1732+2950$

$=4682\approx4700$

**136. (b)** Ravina's monthly income $=32000\times\frac{115}{100}=$ ₹36800

Ramola's monthly income $=3\times36800=$ ₹110400

$\therefore$ Ramola's annual income $=12\times110400=$ ₹1324800

**137. (c)** Converted maximum marks = 700

Converted marks = 336

$\%\text{mark}=\frac{336}{700}\times100=48\%$

$\therefore$ 468 is 48% of maximum marks $A$.

$\therefore\ A=\frac{468}{48}\times100=975$

**138. (e)** According to the question,

$\frac{6}{11}\times\text{First number}=22\%\text{ of second number}$

Second number $=\frac{1}{4}\times$ Third number

or, Second number $=\frac{1}{4}\times2400=600$

or, First number $=\frac{22\times\text{Second number}}{100}\times\frac{11}{6}$

$=\frac{22\times600\times11}{100\times6}\times242$

$\therefore$Required answer $=45\%\text{ of }242=\frac{45\times142}{100}=108.9$

**139. (e)** $\frac{32}{100}\times260=83.2\approx83$

**140. (a)** Amount reinvested in equity funds = 94500

Amount reinvested in debt + equity funds

$=94500\times\frac{13}{7}=175500$

Amount invested earlier in debt + equity funds

$=\frac{175500}{1.3}=135000$

Original amount invested in equity funds

$=\frac{5}{9}\times135000=75000$

**141. (b)** Let the original numbers be $x$ and $y$ and their product be $xy$.

Product of $\frac{1}{3}$ rd of $x$ and 150% of $y=\frac{x}{3}\times\frac{3}{2}y=\frac{xy}{2}$

Required answer $=\frac{xy}{2\times xy}\times100=50\%$

**142. (d)** Salary in June 2011 = 22385

$\therefore$ Salary in June 2009 $=\frac{22385}{1.1\times1.1}=18500$

**143. (d)** Using statement II and III, we can find the number of students in second class and pass class only.

As there in no link given between the first class and the other classes, we cannot find the number of students in first class.

**144. (b)** $\frac{34.5}{100}\times1800+\frac{12.8}{100}\times1500=(?)^3+78$

$\Rightarrow(?)^3=621+186-78$

$\Rightarrow(?)^3=729$

$\therefore\ ?=9$

**145. (a)** $\frac{67}{100}\times800-231=?-\frac{23}{100}\times790$

$\Rightarrow\ 536-231+181.7=?$

$\therefore\ ?=486.7\approx490$

**146. (b)** Second number $=\frac{1}{4}\times2960=740$

Let the first number be $x$. Then,

$\frac{5}{9}x=\frac{25}{100}\times740$

$\Rightarrow x=\frac{9}{5}\times\frac{1}{4}\times740=333$

So, 30% of 1st number $=\frac{30}{100}\times333=99.9$

**147. (b)** Suresh's monthly income = 1.2 × 22000 = ₹26400

Dinesh's monthly income = 26400 × 4 = ₹105600

**148. (b)** Total girls $=\frac{12}{100}\times250=30$

Total boys = 250 – 30 = 220

Each boy's monthly fee = 1.24 × 450 = 558

Total monthly fee of boys and girls together = (220 × 558) + (30 × 450)

= 122760 + 13500 = ₹136260

**149. (e)** Let C's share be ₹$x$.

Then, $B$ gets = $0.75x$

$A$ gets = $1.25\times0.75x$

So, $x+0.75x+0.9375x=731$

$\Rightarrow 2.6875x=731$

$\Rightarrow\ x=\frac{731}{2.6875}=272$

**150. (a)** Ratio of their investments = R:M:P = 50:45:54

Then, Raghu invested $\frac{17880\times50}{149}$ = ₹6000

**151. (a)** Let the original fraction be $\frac{x}{y}$.

Now, according to the question,

$$= \frac{x \times 250}{y \times 400} = \frac{5}{18} \quad \text{or,} \quad \frac{x}{y} = \frac{5 \times 400}{18 \times 250} = \frac{4}{9}$$

**152. (e)** 40% minimum passing marks for boys
= 483 + 117 = 600

$$\Rightarrow \quad 1\% = \frac{600}{40}$$

$$\Rightarrow \quad 100\% = \frac{600}{40} \times 100 = 1500$$

Minimum passing marks for girls
= 35% of 1500 = 35 × 15 = 525

**153. (d)** 12% of $K$ = 16% of $N$
$K \rightarrow$ Kaushal's monthly salary
$N \rightarrow$ Nandini's monthly salary
$S \rightarrow$ Suresh's monthly salary

$$S = \frac{N}{2} \Rightarrow \quad N = 2S$$

$$K = \frac{16}{12} \times N = \frac{16}{12} \times 2S$$

$$= \frac{16}{6} \times \frac{1.08}{12} = \frac{16}{6} \times 0.09 = 0.24 \text{ lakh} = 24{,}000$$

**154. (d)** Sunil's investment $= 6000 \times \frac{70}{100} = ₹1200$

Rita's investment $= 4200 \times \frac{5}{4} = ₹5250$

Total amount invested = 6000 + 4200 + 5250 = ₹15450
Required ratio = 5250:15450 = 35:103

**155. (d)** [15% = (10 + 5)%] of 578 + 20% of 644 + 2.5% of 644
= 57.8 + 28.9 + 128.8 + 2.5 × 6.44
= 86.7 + 128.8 + 5 × 3.22
= 86.7 + 128.8 = 231.6

**156. (b)** Let money invested by Raghu = ₹$x$

Money invested by Mona $= \frac{9}{10}x = 0.9x$

Money invested by Sonu $= \frac{9}{10}x \times \frac{110}{100} = 0.99x$

Also, $x + 0.9x + 0.99x = 5780$

$$\Rightarrow \quad x = \frac{5780}{2.89} = 2000$$

**157. (d)** Remaining monthly income
= (100 − (50 + 20 + 5)% = 25%
Given that 25% = 11,250
⇒ 100% = 4 × 11250 = ₹45000

**158. (a)** Maya's monthly income

$$= 78{,}000 \times \frac{60}{100} \times \frac{100}{120} = ₹39000$$

**159. (c)** Let the fraction be $x/y$.

Then,

$$\frac{x + \frac{240x}{100}}{y - \frac{y}{2}} = \frac{17}{6}$$

$$\Rightarrow \frac{\frac{17x}{5}}{\frac{y}{2}} = \frac{17}{6} \Rightarrow \frac{x}{y} = \frac{5}{12}$$

**160. (d)** $\frac{504 \times 5 \times 5 \times 5 \times 2}{2 \times 3 \times 3 \times 4 \times 5} = 350$

**161. (e)** Required percentage is

$$\frac{60 - 40 \times \frac{65}{100}}{40} \times 100 = \frac{34}{40} \times 100 = 85\%$$

**Note:**

Using alligation. Since ratio is 1:1, 75% should be between 65% and the required percentage = 85%

**162. (b)** Let the Raman's expense be ₹$x$.

Then, Vimal's expense $= ₹x\left(\frac{100-10}{100}\right) = ₹\frac{9x}{10}$

and, Aman's expense $= ₹\frac{9x}{10}\left(\frac{100+30}{100}\right) = ₹\frac{117x}{100}$.

Now, according to the question,

$$₹\left(x + \frac{9x}{10} + \frac{117x}{100}\right) = ₹6447$$

$$\Rightarrow \quad 100x + 90x + 117x = 6447 \times 100$$

$$\Rightarrow \quad x = \frac{6447 \times 100}{307} - 2100$$

$$\therefore \quad \text{Aman's expense} = ₹\frac{117 \times 2100}{100} = ₹2457$$

**163. (c)** 35% = 40 + 30 marks, 100% = 200 marks

# Average

# 6

## INTRODUCTION

Whenever we are asked the marks we scored in any examination, we usually tell the marks in terms of percentage, that is, taking the percentage of total marks of all subjects. This percentage is called *average percentage*. Also, in a class, if there are 100 students, instead of knowing the age of individual student, we usually talk about their average age.

The *average* or *mean* or *arithmetic mean* of a number of quantities of the same kind is equal to their sum divided by the number of those quantities. For example, the average of 3, 9, 11, 15, 18, 19 and 23 is

$$\frac{3+9+11+15+18+19+23}{7} = \frac{98}{7} = 14.$$

## SOME BASIC FORMULAE

1. Average $= \dfrac{\text{Sum of quantities}}{\text{Number of quantities}}$
2. Sum of quantities = Average × Number of quantities
3. Number of quantities $= \dfrac{\text{Sum of quantities}}{\text{Average}}$

**Illustration 1:** A man purchased 5 toys at ₹200 each, 6 toys at ₹250 each and 9 toys at ₹300 each. Calculate the average cost of 1 toy.

**Solution:** Price of 5 toys = 200 × 5 = ₹1000

Price of 6 toys = 250 × 6 = ₹1500

Price of 9 toys = 300 × 9 = ₹2700

Total number of toys = 5 + 6 + 9 = 20

$$\text{Average price of 1 toy} = \frac{1000+1500+2700}{20}$$

$$= \frac{5200}{20} = ₹260.$$

**Illustration 2:** The average marks obtained by 200 students in a certain examination is 45. Find the total marks.

**Solution:** Total marks

= Average marks × Number of students

= 200 × 45 = 900.

**Illustration 3:** Total temperature for the month of September is 840°C. If the average temperature of that month is 28°C, find out the number of days is the month of September.

**Solution:** Number of days in the month of September

$$= \frac{\text{Total temperature}}{\text{Average temperature}} = \frac{840}{28}$$

= 30 days.

## SOME USEFUL SHORTCUT METHODS

1. Average of two or more groups taken together.
   (a) If the number of quantities in two groups be $n_1$ and $n_2$ and their average is $x$ and $y$, respectively, the combined average (average of all of them put together) is

$$\frac{n_1x+n_2y}{n_1+n_2}$$

**Explanation**

Number of quantities in the first group = $n_1$

Their average = $x$

∴ Sum = $n_1 \times x$

Number of quantities in the second group = $n_2$

Their average = $y$

∴ Sum = $n_2 \times y$

Number of quantities in the combined group = $n_1 + n_2$.

Total sum (sum of quantities of the first group and the second group) = $n_1x + n_2y$.

∴ Average of the two groups

$$= \frac{n_1x + n_2y}{n_1 + n_2}.$$

(b) If the average of $n_1$ quantities is $x$, and the average of $n_2$ quantities out of them is $y$, the average of the remaining group (rest of the quantities) is

$$\frac{n_1x - n_2y}{n_1 - n_2}.$$

**Explanation**

Number of quantities = $n_1$

Their average = $x$

∴ Sum = $n_1 x$

Number of quantities taken out = $n_2$

Their average = $y$

∴ Sum = $n_2y$

Sum of remaining quantities = $n_1x - n_2y$

Number of remaining quantities = $n_1 - n_2$

∴ Average of the remaining group $= \dfrac{n_1x - n_2y}{n_1 - n_2}$.

**Illustration 4:** The average weight of 24 students of section $A$ of a class is 58 Kg, whereas the average weight of 26 students of section $B$ of the same class is 60.5 Kg. Find out average weight of all the 50 students of the class.

**Solution:** Here, $n_1 = 24$, $n_2 = 26$, $x = 58$, and $y = 60.5$.

∴ Average weight of all the 50 students

$$= \frac{n_1x + n_2y}{n_1 + n_2}$$

$$= \frac{24 \times 58 + 26 \times 60.5}{24 + 26}$$

$$= \frac{1392 + 1573}{50} = \frac{2965}{50} = 59.3 \text{ Kg}.$$

**Illustration 5:** Average salary of all the 50 employees including 5 officers of a company is ₹850. If the average salary of the officers is ₹2500, find the average salary of the remaining staff of the company.

**Solution:** Here, $n_1 = 50$, $n_2 = 5$, $x = 850$ and $y = 2500$.

∴ Average salary of the remaining staff

$$= \frac{n_1x - n_2y}{n_1 - n_2} - \frac{50 \times 850 - 5 \times 2500}{50 - 5}$$

$$= \frac{42500 - 12500}{45} = \frac{30000}{45}$$

= ₹667 (approx.)

2. If $x$ is the average of $x_1, x_2, \ldots, x_n$, then
   (a) The average of $x_1 + a, x_2 + a, \ldots, x_n + a$ is $x + a$.
   (b) The average of $x_1 - a, x_2 - a, \ldots x_n - a$ is $x - a$.
   (c) The average of $ax_1, ax_2, \ldots, ax_n$ is $ax$, provided $a \neq 0$.
   (d) The average of $\frac{x_1}{a}, \frac{x_2}{a}, \ldots, \frac{x_n}{a}$ is $\frac{\overline{x}}{a}$, provided $a \neq 0$.

**Illustration 6:** The average value of six numbers 7, 12, 17, 24, 26 and 28 is 19. If 8 is added to each number, what will be the new average?

**Solution:** The new average $= \overline{x} + a$

$= 19 + 8 = 27$.

**Illustration 7:** The average of $x$ numbers is $5x$. If $x - 2$ is subtracted from each given number, what will be the new average?

**Solution:** The new average $= \overline{x} - a$

$= 5x - (x - 2) = 4x + 2$.

**Illustration 8:** The average of 8 numbers is 21. If each of the numbers is multiplied by 8, find the average of a new set of numbers.

**Solution:** The average of a new set of numbers

$= a\overline{x} = 8 \times 21 = 168$

3. The average of $n$ quantities is equal to $x$. If one of the given quantities whose value is $p$, is replaced by a new quantity having value $q$, the average becomes $y$, then $q = p + n(y - x)$.

**Illustration 9:** The average weight of 25 persons is increased by 2 Kg when one of them whose weight is 60 Kg, is replaced by a new person. What is the weight of the new person?

**Solution:** The weight of the new person

$= p + n(y - x)$

$= 60 + 25(2) = 110$ Kg.

4. (a) The average of $n$ quantities is equal to $x$. When a quantity is removed, the average becomes $y$. The value of the removed quantity is $n(x - y) + y$.
   (b) The average of $n$ quantities is equal to $y$. When a quantity is added, the average becomes $y$. The value of the new quantity is $n(y - x) + y$.

**Illustration 10:** The average age of 24 students and the class teacher is 16 years. If the class teacher's age is excluded, the average age reduces by 1 year. What is the age of the class teacher?

**Solution:** The age of class teacher

$= n(x - y) + y$

$= 25(16 - 15) + 15 = 40$ years.

**Illustration 11:** The average age of 30 children in a class is 9 years. If the teacher's age be included, the average age becomes 10 years. Find the teacher's age.

**Solution:** The teacher's age

$= n(y - x) + y$

$= 30(10 - 9) + 100 = 40$ years.

5. (a) The average of first $n$ natural numbers is $\frac{n+1}{2}$.
   (b) The average of square of natural numbers till $n$ is $\frac{(n+1)(2n+1)}{6}$.
   (c) The average of cubes of natural numbers till $n$ is $\frac{n(n+1)^2}{4}$.
   (d) The average of odd numbers from 1 to $n$ is $\frac{\text{last odd number} + 1}{2}$.
   (e) The average of even numbers from 1 to $n$ is $\frac{\text{last even number} + 2}{2}$.

**Illustration 12:** Find the average of first 81 natural numbers.

**Solution:** The required average

$$= \frac{n+1}{2} = \frac{81+1}{2} = 41.$$

**Illustration 13:** What is the average of squares of the natural numbers from 1 to 41?

**Solution:** The required average

$$= \frac{(n+1)(2n+1)}{6} = \frac{(41+1)(2\times 41+1)}{6}$$

$$= \frac{42\times 83}{6} = \frac{3486}{6} = 581.$$

**Illustration 14:** Find the average of cubes of natural numbers from 1 to 27.

**Solution:** The required average

$$= \frac{n(n+1)^2}{4} = \frac{27\times(27+1)^2}{4}$$

$$= \frac{27\times 28\times 28}{4} = \frac{21168}{4} = 5292.$$

**Illustration 15:** What is the average of odd numbers from 1 to 40?

**Solution:** The required average

$$= \frac{\text{last odd number} + 1}{2} = \frac{39+1}{2} = 20.$$

**Illustration 16:** What is the average of even numbers from 1 to 81?

**Solution:** The required average

$$= \frac{\text{last even number} + 2}{2} = \frac{80+2}{2} = 41.$$

6. (a) If $n$ is odd: The average of $n$ consecutive numbers, consecutive even numbers or consecutive odd numbers is always the middle number.
   (b) If $n$ is even: The average of $n$ consecutive numbers, consecutive even numbers or consecutive odd numbers is always the average of the middle two numbers.
   (c) The average of first $n$ consecutive even numbers is $(n + 1)$.
   (d) The average of first $n$ consecutive odd numbers is $n$.
   (e) The average of squares of first $n$ consecutive even numbers is $\frac{2(n+1)(2n+1)}{3}$.
   (f) The average of squares of consecutive even numbers till $n$ is $\frac{(n+1)(n+2)}{3}$.
   (g) The average of squares of consecutive odd numbers till $n$ is $\frac{n(n+2)}{3}$.
   (h) If the average of $n$ consecutive numbers is $m$, then the difference between the smallest and the largest number is $2(n - 1)$.

**Illustration 17:** Find the average of 7 consecutive numbers 3, 4, 5, 6, 7, 8, 9.

**Solution:** The required average = middle number = 6.

**Illustration 18:** Find the average of consecutive odd numbers 21, 23, 25, 27, 29, 31, 33, 35.

**Solution:** The required average

= average of middle two numbers

= average of 27 and 29

$$= \frac{27+29}{2} = 28.$$

**Illustration 19:** Find the average of first 31 consecutive even numbers.

**Solution:** The required average = $(n + 1) = 31 + 1 = 32$.

**Illustration 20:** Find the average of first 50 consecutive odd numbers.

**Solution:** The required average = $n$ = 50.

**Illustration 21:** Find the average of squares of first 19 consecutive even numbers.

**Solution:** The required average $= \dfrac{2(n+1)(2n+1)}{3}$

$$= \frac{2(19+1)(2\times 19+1)}{3}$$

$$= \frac{2\times 20\times 39}{3}$$

$$= \frac{1560}{3} = 520.$$

**Illustration 22:** Find the average of squares of consecutive even numbers from 1 to 25.

**Solution:** The required average

$$= \frac{(n+1)(n+2)}{3} = \frac{(25+1)(25+2)}{3}$$

$$= \frac{26\times 27}{3} = \frac{702}{3} = 234.$$

**Illustration 23:** Find the average of squares of consecutive odd numbers from 1 to 31.

**Solution:** The required average

$$= \frac{n(n+2)}{3} = \frac{31\times(31+2)}{3}$$

$$= \frac{31\times 33}{3} = 341.$$

**Illustration 24:** If the average of 6 consecutive numbers is 48, what is the difference between the smallest and the largest number?

**Solution:** The required difference

$= 2(n - 1) = 2(6 - 1) = 10$.

> 7. Geometric Mean or Geometric Average.
> Geometric mean of $x_1, x_2, \ldots, x_n$ is denoted by
>
> $$\text{G.M.} = \sqrt[n]{x_1 \times x_2 \times \cdots \times x_n}.$$
>
> Geometric mean is useful in calculating averages of ratios such as average population growth rate, average percentage increase and, so on.

**Illustration 25:** The production of a company for three successive years has increased by 10%, 20% and 40%, respectively. What is the average annual increase of production?

**Solution:** Geometric mean of $x$, $y$ and $z = (x\times y\times z)^{1/3}$.

$\therefore$ Average increase = $(10 \times 20 \times 40)^{1/3}\% = 20\%$

**Illustration 26:** The population of a city in two successive years increases at the rates of 16% and 4%, respectively. Find out the average increase in two years.

**Solution:** In case of population increase, the geometric mean is required.

$\therefore$ Geometric mean of 16% and 4% is

$= (16 \times 4)^{1/2}\%$, i.e., 8%

> 8. Harmonic Mean or Harmonic Average.
> Harmonic mean of $x_1, x_2, \ldots, x_n$ is denoted by
>
> $$\text{H.M.} = \frac{1}{\dfrac{1}{n}\left(\dfrac{1}{x_1}+\dfrac{1}{x_2}+\cdots+\dfrac{1}{x_n}\right)}$$
>
> Harmonic mean is useful in finding out average speed of a vehicle, average production per day and, so on.

**Illustration 27:** A man runs 1 Km at a speed of 15 Km/h and another 1 Km he walks at a speed of 5 Km/h. Find out his average speed in covering 2 Km.

**Solution:** Harmonic mean is used when distance remains constant and speed varies. Harmonic mean of $x$ and $y$ is $\dfrac{2}{\dfrac{1}{x}+\dfrac{1}{y}}$ or, $\dfrac{2xy}{x+y}$.

$\therefore$ Average speed for the whole distance

$$= \frac{2\times 15\times 5}{15+5} = 7.5 \text{ Km/h}.$$

> 9. If a certain distance is covered at a speed of $x$ Km/h and the same distance is covered at a speed of $y$ Km/h, the average speed during the entire journey is
>
> $$\left(\frac{2xy}{x+y}\right) \text{Km/h}.$$

**Illustration 28:** If half of the journey is travelled at a speed of 15 Km/h and the remaining half at a speed of 12 Km/h, find out average speed during the entire journey

**Solution:** The average speed

$$= \left(\frac{2xy}{x+y}\right) = \left(\frac{2\times15\times12}{15+12}\right)$$

$$= \frac{360}{27} = 13\frac{1}{3} \text{ Km/h.}$$

**Illustration 29:** A man goes to a certain place at a speed of 30 Km/h and returns to the original place at a speed of 20 Km/h, find out his average speed during this up and down journey.

**Solution:** The average speed

$$= \left(\frac{2xy}{x+y}\right) = \left(\frac{2\times30\times20}{30+20}\right) = \frac{1200}{50}$$

$= 24$ Km/h.

10. If a person or a motor car covers three equal distances at the speed of $x$ Km/h, $y$ Km/h and $z$ Km/h, respectively, then for the entire journey average speed of the person or motor car is $\left(\frac{3xzy}{xy+yz+zx}\right)$ Km/h.

**Illustration 30:** A train covers the first 160 Km at a speed of 120 Km/h, another 160 Km at 140 Km/h and the last 160 Kms at 80 Km/h. Find out average speed of the train for the entire journey.

**Solution:** Average speed $= \frac{3xyz}{xy+yz+zx}$

$$= \frac{3\times120\times140\times80}{120\times140+140\times80+80\times120}$$

$$= \frac{360\times140\times80}{16800+11200+9600} = \frac{4032000}{37600}$$

$$= 107\frac{11}{47} \text{ Km/h.}$$

11. If a person covers A Km at a speed of $x$ Km/h, B Km at a speed of $y$ Km/h and $C$ Km at a speed of $z$ Km/h, the average speed during the entire journey is

$$\left(\frac{A+B+C}{\frac{A}{x}+\frac{B}{y}+\frac{C}{z}}\right) \text{Km/h.}$$

**Illustration 31:** A person covers 9 Km at a speed of 3 Km/h, 25 Km at a speed of 5 Km/h and 30 Km at a speed of 10 Km/h. Find out average speed for the entire journey.

**Solution:** The average speed $= \left(\frac{A+B+C}{\frac{A}{x}+\frac{B}{y}+\frac{C}{z}}\right)$

$$= \left(\frac{9+25+30}{\frac{9}{3}+\frac{25}{5}+\frac{30}{10}}\right)$$

$$= \frac{64}{11} = 5\frac{9}{11} \text{ Km/h.}$$

12. If a person covers $A$th part of the distance at $x$ Km/h, $B$th part of the distance at $y$ Km/h and the remaining $C$th part at $z$ Km/h, then the average speed during the entire journey is

$$\left(\frac{1}{\frac{A}{x}+\frac{B}{y}+\frac{C}{z}}\right) \text{Km/h.}$$

**Illustration 32:** A person covers the first $\frac{1}{4}$ of the distance at 8 Km/h, the next $\frac{3}{5}$ at 6 Km/h and the remaining distance at 15 Km/h. Find the average speed during the entire journey.

**Solution:** The average speed

$$= \frac{1}{\left(\frac{A}{x}+\frac{B}{y}+\frac{C}{z}\right)} = \left(\frac{1}{\frac{1/4}{8}+\frac{3/5}{6}+\frac{3/20}{15}}\right)$$

$$\left[\text{Here, } A = \frac{1}{4},\ B = \frac{3}{5} \text{ and } C = 1-\left(\frac{1}{4}+\frac{3}{5}\right) = \frac{3}{20}\right]$$

$$= \frac{1}{\frac{1}{32}+\frac{1}{10}+\frac{1}{100}} = \frac{3200}{452} = 7\frac{9}{113} \text{ Km/h.}$$

**Illustration 33:** A train covers 50% of the journey at 30 Km/h, 25% of the journey at 25 Km/h and the remaining at 20 Km/h. Find the average speed of the train during the entire journey.

**Solution:** The average speed

$$= \left(\frac{100}{\frac{A}{x}+\frac{B}{y}+\frac{C}{z}}\right) = \left(\frac{100}{\frac{50}{30}+\frac{25}{25}+\frac{25}{20}}\right)$$

[Here, $A$ = 50, $B$ = 25 and $C$ = 25]

$$= \frac{100}{47/12} = \frac{1200}{47} = 25\frac{25}{47} \text{ Km/h.}$$

## Exercise-I

1. The daily earnings of a taxi driver during a week are: ₹60, ₹65, ₹70, ₹52. 50, ₹63, ₹73 and ₹68. What is his average daily earning for the week?
   (a) ₹74.50 (b) ₹54.50
   (c) ₹64.50 (d) ₹84.50
2. The average of 10 numbers is 7. What will be the new average if each of the numbers is multiplied by 8?
   (a) 45 (b) 52
   (c) 56 (d) 55
3. The average weight of 5 persons, sitting in a boat, is 38 Kg. If the average weight of the boat and the persons sitting in the boat is 52 Kg, what is the weight of the boat?
   (a) 228 Kg (b) 122 Kg
   (c) 232 Kg (d) 242 Kg
4. There are 35 students in a hostel. If the number of students increased by 7, the expenses of the mess were increased by ₹42 per day while the average expenditure per head decreased by ₹1. Find out the actual expenditure of the mess.
   (a) ₹480 (b) ₹440
   (c) ₹520 (d) ₹420
5. The daily maximum temperature in Delhi, for 7 consecutive days in May 1988, were 42.7°C, 44.6°C, 42.0°C, 39.1°C, 43.0°C, 42.5°C and 38.5°C. Find out the average daily maximum temperature.
   (a) 42.63° C (b) 45.65° C
   (c) 41.77° C (d) 39.60° C
6. The average salary per head of all the workers in a workshop is ₹850. If the average salary per head of 7 technicians is ₹1000 and the average salary per head of the rest is ₹780, find out the total number of workers in the workshop.
   (a) 26 (b) 24
   (c) 28 (d) 22
7. An aeroplane travels 2500 Km, 1200 Km and 500 Km at 500 Km/h, 400 Km, and 250 Km/h, respectively. The average speed is:
   (a) 420 Km/h (b) 410 Km/h
   (c) 405 Km/h (d) 575 Km/h
8. In an examination, out of 20 students in a class, in Mathematics 2 students scored 100 marks, 3 students scored 0, and average marks for rest of the students was 40. What is the average mark of the whole class?
   (a) 40 marks (b) 35 marks
   (c) 32 marks (d) 45 marks
9. The average weight of 24 students in section A of a class is 58 Kg, whereas the average weight of 26 students in section B of the same class is 60.5 Kg. Find out the average weight of all the 50 students of the class.
   (a) 57.4 Kg (b) 59.3 Kg
   (c) 58.9 Kg (d) 59.7 Kg
10. The average age of 5 members is 21 years. If the age of the youngest member be 5 years, find out the average age of the family at the birth of the youngest member.
    (a) 24 years (b) 25 years
    (c) 20 years (d) 28 years
11. The average of 7 numbers is 5. If the average of first six of these numbers is 4, the seventh number is:
    (a) 14 (b) 12
    (c) 11 (d) 15
12. Three years ago the average age of a family of 5 members was 27 years. On addition of a child to the family, the present average age of the family is still 27 years. Find out the present age of the child.
    (a) 16 years (b) 12 years
    (c) 24 years (d) 20 years
13. The average weight of 10 students is increased by half a Kg when one of the students weighing 50 Kg is replaced by a new student. Find out the weight of the new student.
    (a) 55 Kg (b) 60 Kg
    (c) 45 Kg (d) 40 Kg
14. The average monthly salary of a staff of 9 persons is ₹2450. One member of the staff whose monthly salary is ₹2650 is transferred. Find out the average salary of the remaining 8 persons of the staff.
    (a) ₹2425 (b) ₹2625
    (c) ₹3025 (d) ₹2825
15. The mean marks of 10 boys in a class is 70%, whereas the mean marks of 15 girls is 60%. The mean marks of all the 25 students is:
    (a) 64% (b) 60%
    (c) 55% (d) 52%

**16.** The average income of A for 15 days is ₹70. The average for first five days is ₹60 and that for the last nine days is ₹80. A's income for the sixth day is:

(a) ₹80 (b) ₹60
(c) ₹40 (d) ₹30

**17.** The average of five consecutive even numbers starting with 4, is:

(a) 6 (b) 7
(c) 8 (d) 7.5

**18.** Three years ago the average age of a family of 5 members was 17 years. With the birth of a new baby, the average remains the same three even today. Find out the age of the baby.

(a) 1 year (b) 3 years
(c) $2\frac{1}{2}$ years (d) 2 years

**19.** The average of 17 numbers is 10.9. If the average of first nine numbers is 10.5 and that of the last 9 numbers is 11.4, the middle number is:

(a) 11.8 (b) 11.4
(c) 10.9 (d) 11.7

**20.** A batsman has a certain average of runs for 12 innings. In the 13th innings, he scores 96 runs and thereby increasing his average by 5 runs. What is his average after the 13th innings?

(a) 48 (b) 64
(c) 36 (d) 72

**21.** A batsman in his 17th innings, makes a score of 85 runs, and thereby, increases his average by 3 runs. What is his average after the 17th innings? He had never been 'not out'.

(a) 47 (b) 37
(c) 39 (d) 43

**22.** The sum of three numbers is 98. If the ratio between first and second be 2:3 and between second and third be 5:8, then the second number is:

(a) 30 (b) 20
(c) 58 (d) 48

**23.** The average weight of 8 sailors in a boat is increased by 1 Kg if one of them weighing 56 Kg is replaced by a new sailor. The weight of the new sailor is:

(a) 57 Kg (b) 60 Kg
(c) 64 Kg (d) 62 Kg

**24.** A number, $x$, equals 80% of the average of 5, 7, 14 and a number $y$. If the average of $x$ and $y$ is 26, then value of $y$ is:

(a) 13 (b) 26
(c) 39 (d) None of these

**25.** The average age of A, B, C, D five years ago was 45 years. By including $x$, the present average age of all the five is 49 years. The present age of $x$ is:

(a) 64 years (b) 48 years
(c) 45 years (d) 40 years

**26.** It rained as much on Wednesday as on all the others days of the week combined. If the average rainfall for the whole week was 3 cm, then much did it rain on Wednesday?

(a) 2.625 cm (b) 3 cm
(c) 10.5 cm (d) 15 cm

**27.** The average monthly expenditure of a family for the first four months is ₹2750, for the next three months is ₹2940, and for the last five months ₹3130. If the family saves ₹5330 throughout year, find the average monthly income of the family for that year.

(a) ₹3800 (b) ₹3500
(c) ₹3400 (d) ₹4200

**28.** The average age of 8 men is increased by 2 years. When 2 of them, whose ages are 20 years and 24 years respectively, are replaced by 2 women. What is the average age of these two women?

(a) 36 years (b) 30 years
(c) 40 years (d) 42 years

**29.** The average of 50 numbers is 38. If two numbers 45 and 55 are discarded, the average of the remaining set of numbers is:

(a) 38.5 (b) 37.5
(c) 37.0 (d) 36.5

**30.** The average speed of a train running at a speed of 30 Km/h during the first 100 kilometres, at 40 Km/h during the second 100 kilometres and at 50 Km/h during the last 100 kilometres is nearly:

(a) 38.5 Km/h (b) 38.3 Km/h
(c) 40.0 Km/h (d) 39.2 Km/h

**31.** The average of 6 observations is 12. A new seventh observation is included and the new average is decreased by 1. The seventh observation is:

(a) 1 (b) 3
(c) 5 (d) 6

**32.** The average age of 20 boys in the class is 15.6 years. Five new boys join and the new average becomes 15.56 years. What was the average age of the five new boys?

(a) 15.5 (b) 15.4
(c) 15.25 (d) 15.3

**33.** The average weight of 3 men A, B and C is 84 Kg. Another man, D, joins the group, and the average weight becomes 80 Kg. If another man, E, whose weight is 3 Kg more than that of D, replaces A, then average weight of B, C, D and E becomes 79 Kg. The weight of A is:
(a) 70 Kg (b) 72 Kg
(c) 75 Kg (d) 80 Kg

**34.** There was one mess for 30 boarders in a certain hostel. On the number of boarders being increased by 10, the expenses of the mess were increased by ₹40 per month while the average expenditure per head diminished by ₹2. Find out actual monthly expenses.
(a) ₹390 (b) ₹410
(c) ₹360 (d) ₹480

**35.** Of the three numbers, the first is twice the second and the second is thrice the third. If the average of the three numbers is 10, the numbers are:
(a) 18, 3, 9 (b) 9, 3, 18
(c) 3, 9, 18 (d) 18, 9, 3

**36.** The average weight of 36 students is 50 Kg. It was found later that the figure of 37 Kg was misread as 73 Kg. What is the correct average?
(a) 49 Kg (b) 51 Kg
(c) 50.5 Kg (d) None of these

**37.** The average earning of a mechanic for the first four days of a week is ₹18 and for the last four days is ₹22. If he earns ₹20 on the fourth day, his average earning for the whole week is:
(a) ₹18.95 (b) ₹16
(c) ₹20 (d) ₹25.71

**38.** The average of marks obtained by 120 candidates was 35. If the average of marks of passed candidates was 39 and that of failed candidates was 15, the number of candidates who passed the examination is:
(a) 100 (b) 110
(c) 120 (d) 150

**39.** In a class, there are 20 boys whore average age is decreased by 2 months, when one boy aged 18 years in replaced by a new boy. The age of the new boy is:
(a) 14 years and 8 months
(b) 15 years
(c) 16 years 4 months
(d) 17 years 10 months

**40.** The average temperature from Monday to Thursday is 48°C and from Tuesday to Friday is 52°C. If the temperature on Monday is 42°C, what was it on Friday?
(a) 52°C (b) 55°C
(c) 58°C (d) 51°C

**41.** A man spends on an average ₹269.47 for the first 7 months and ₹281.05 for the next 5 months. Find out his monthly salary if he saved ₹308.46 during the year.
(a) ₹400 (b) ₹500
(c) ₹300 (d) ₹600

**42.** The average of two numbers is 62. If 2 is added to the smaller number, the ratio between the numbers becomes 1:2. The smaller number is:
(a) 60 (b) 30
(c) 84 (d) 40

**43.** In a coconut grove, $(x + 2)$ trees yield 60 nuts per year, $x$ trees yield 120 nuts per year, and $(x - 2)$ trees yield 180 nuts per year. If the average yield per year per tree be 100, find the value of $x$.
(a) 4 (b) 2
(c) 8 (d) 6

**44.** Average temperature of first 4 days of a week is 38.6°C and that of the last 4 days is 40.3°C. If the average temperature of the week be 39.1°C, the temperature on 4th day is.
(a) 36.7°C (b) 38.6°C
(c) 39.8°C (d) 41.9°C

**45.** The average daily wages of A, B and C is ₹120. If B earns ₹40 more than C per day and A earns double of what C earns per day, the wages of A per day is
(a) ₹80 (b) ₹120
(c) ₹160 (d) ₹100

**46.** With an average speed of 40 Km/h, a train reaches its destination on time. If it goes with an average speed of 35 Km/h, it reaches late by 15 minutes. The total journey is:
(a) 30 Km (b) 40 Km
(c) 70 Km (d) 80 Km

**47.** In a competitive examination, the average marks obtained was 45. It was later discovered that there was some error in computerization and the marks of 90 candidates had to be changed from 80 to 50, and the average came down to 40 marks. The total number of candidates appeared in the examination is:
(a) 520 (b) 550
(c) 540 (d) 525

**48.** Visitors to a show were charged ₹15.00 each on the first day, ₹7.50 on the second, ₹2.50 on the third day. Visitors total attendance for three days were in the ratio 2:5:13. Find out the average charge per visitor for the entre show.

(a) ₹7 (b) ₹5
(c) ₹9 (d) ₹11

**49.** The mean daily profit made by a shopkeeper, in a month of 30 days, was ₹350. If the mean profit for the first 15 days was ₹275, then the mean profit for the last 15 days would be:

(a) ₹200 (b) ₹275
(c) ₹350 (d) ₹425

**50.** A man whose bowling average is 12.4, takes 5 wickets for 26 runs and, thereby, decreases his average by 0.4. The number of wickets, taken by him, before his last match is:

(a) 85 (b) 78
(c) 72 (d) 64

**51.** Out of three numbers, the first is twice the second and is half of the third. If the average of the three numbers is 56, the three numbers in order are:

(a) 48, 96, 24 (b) 48, 24, 96
(c) 96, 24, 48 (d) 96, 48, 24

**52.** There were 35 students in a hostel. If the number of students increases by 7, the expenses of the mess increase by ₹42 per day while the average expenditure per head diminishes by ₹1. Find the actual expenditure of the mess.

(a) ₹480 (b) ₹420
(c) ₹520 (d) ₹460

**53.** The average of 50 numbers is 38. If two numbers, namely, 45 and 55 are discarded, what is the average of the remaining numbers?

(a) 37.5 (b) 38.5
(c) 39.5 (d) 36.5

**54.** In a cricket team of 11 boys, one player weighing 42 Kg is injured and replaced by another player. If the average weight of the team is increased by 100 gm as a result of this, then what is the weight of the new player?

(a) 42.1 Kg (b) 45.1 Kg
(c) 44.1 Kg (d) 43.1 Kg

**55.** The average of these consecutive numbers is *n*. If the next two consecutive numbers are also included, the average of the five numbers will:

(a) remain the same. (b) increase by 0.5.
(c) increase by 1. (d) increase by 1.5.

**56.** The average salary of 20 workers in an office is ₹1900 per month. If the manager's salary is added, the average becomes ₹2000 per month. The manager's salary (in ₹) is:

(a) 24000 (b) 25200
(d) 45600 (d) None of these

**57.** The average age of students of a class is 15.8 years. The average age of boys in the class is 16.4 years and that of the girls is 15.4 years. The ratio of number of boys to the number of girls in the class is:

(a) 1:2 (b) 3:4
(c) 3:5 (d) 2:3

**58.** The average expenditure of a man for the first five months is ₹3600 and for next seven months it is ₹3900. If he saves ₹8700 during the year, his average income per month is:

(a) ₹4500 (b) ₹4200
(c) ₹4050 (d) ₹3750

**59.** Of the three numbers, second is twice the first and is also thrice the third. If the average of the three numbers is 44, the largest number is:

(a) 24 (b) 36
(c) 72 (d) 108

**60.** The average age of a committee of 8 members is 40 years. A member, aged 55 years, retired and he was replaced by a member aged 39 years. The average age of the present committee is:

(a) 39 years (b) 38 years
(c) 36 years (d) 35 years

## Exercise-2
## (Based on Memory)

**1.** The mean of the marks obtained by 100 students is 60. If the marks obtained by one of the students was incorrectly calculated as 75, whereas the actual marks obtained by him was 65, what is the correct mean of the marks obtained by the students?

(a) 59 (b) 58.50
(c) 50 (d) None of these

**[NABARD PO, 2008]**

**2.** In one-day cricket match the captain of one of the teams scored 30 runs more than the average runs

scored by the reamaining six batsmen of that team who batted in the match. If the total runs scored by all the batsmen of that team were 310, how many runs did the captain score?

(a) 60 (b) 70
(c) 50 (d) Cannot be determined
(e) None of these

**[SBI PO, 2005]**

**3.** The average of four number $A$, $B$, $C$ and is 40. The average of four numbers $A$, $B$, $E$ and F is also 40. ($A$, $B$ are common). Which of the following must be true?

(a) $(A+B) \neq (C+D)$
(b) $(C+D)=(E+F)$
(c) Either $C = E$ or $F$; and $D = F =$ or $E$
(d) $C = E =$ and $D = F$

**[SBI PO, 2005]**

**4.** The average (Arithmetic Mean) and the Median of a set of numbers is the same. Which of the following must be true?

(a) All the numbers are odd in the set
(b) All the numbers are even in the set
(c) All numbers are consecutive integers in the set
(d) The data set has even numbers of observations
(e) None of these

**[SBI PO, 2005]**

**5.** The average of four positive integers is 72.5. The highest integer is 117 and the lowest integer is 15. The difference between the remaining two integers is 12. Which is the higher of these two remaining integers?

(a) 73 (b) 84
(c) 70 (d) Cannot be determined
(e) None of these

**[Bank of Maharashtra (SO), 2006]**

**6.** If $16a + 16b = 48$, what is the average of $a$ and $b$?

(a) 3 (b) 2.5
(c) 1.5 (d) 5
(e) None of these

**[Bank of Maharashtra (SO), 2006]**

**7.** A, B, C and D are four consecutive even numbers respectively and their average is 65. What the product of A and D?

(a) 3968 (b) 4216
(c) 4092 (d) 4352
(e) None of these

**[Bank of Baroda PO, 2007]**

**8.** The sum of five numbers is 555. The average of the first two numbers is 75 and the third number is 115. What is the average of the last two numbers?

(a) 145 (b) 290
(c) 265 (d) 150
(e) None of these

**[Bank of Baroda PO, 2007]**

**9.** The average age of A, B and C is 26 years, if the average age of A and C is 29 years, what is the age of B in years?

(a) 26 (b) 20
(c) 29 (d) 23
(e) None of these

**[IDBI Bank Officers', 2007]**

**10.** The sum of three consecutive even numbers is 44 more than the average of these numbers. Which of the following is the third (largest) of these numbers?

(a) 16 (b) 18
(c) 24 (d) Cannot be determined
(e) None of these

**[IDBI Bank Officers', 2007]**

**11.** Average weight of 10 boys is more than the average weight of 15 girls by 5 Kg. If the total weight of the 10 boys is 550, what is the average weight of the 10 boys and 15 girls together?

(a) 52 Kg (b) 52.5 Kg
(c) 53 Kg (d) 53.5 Kg
(e) None of these

**[PNB Management Trainee, 2007]**

**12.** The average age of a class of 65 boys was 14 years, the average age of 20 of them was 14 years, and that of another 15 was 12 years, Find the average age of the remaining boys.

(a) 16 years (b) 13 years
(c) 17 years (d) 15 years
(e) None of these

**[Corporation Bank PO, 2007]**

**13.** The average of 5 numbers is is 306.4. The average of the first two numbers is 431 and the average of the last two numbers is 214.5. What is the third number?

(a) 108 (b) 52
(c) 321 (d) Cannot be determined
(e) None of these

**[Bank of Maharashtra PO, 2008]**

**14.** Kamlesh bouth 65 books for ₹1,050 from one shop and 50 books for ₹1,020 from antoher. What is the average price he paid per book?

(a) ₹36.40 (b) ₹18.20
(c) ₹24 (d) ₹18
(e) None of these

**[Bank of Maharashtra PO, 2008]**

**15.** A, B, C and D are four consectuvie odd numbers and their average is 42. What is the producto of B and D?

(a) 36 (b) 40
(c) 1845 (d) 60
(e) None of these

**[Andhra Bank PO, 2006]**

**16.** The sum of five numbers is 260. The average of the first two numbers is 30 and average of the last two numbers is 70. What is the third number?

(a) 33 (b) 60
(c) 75 (d) Cannot be determined
(e) None of these

**[Andhra Bank PO, 2006]**

**17.** The average of 5 consecutive odd numbers A, B, C, D and E is 47. What is the product of A and D?

(a) 2107 (b) 1935
(c) 2021 (d) 2193
(e) None of these

**[LIC ADO, 2007]**

**18.** In a school, the average age of students is 6 years, and the average age of 12 teachers is 40 years. If the average age of the combined group of all the teachers and the students is 7 years, then the numbe of students is:

(a) 396 (b) 400
(c) 408 (d) 416

**[SSC (GL) Prel. Examination, 2005]**

**19.** A grocer has a sale of ₹6435, ₹6927, ₹6855, ₹7230 and ₹6562 for 5 consecutive months. How much sale must he have in the sixth month so that he gets an average sale of ₹6500?

(a) ₹4991 (b) ₹5991
(c) ₹6991 (d) ₹6001

**[SSC (GL) Prel. Examination, 2003]**

**20.** The average weight of three men A, B and C is 84 Kg. D joins them and the average weight of the four becomes 80 Kg. If E, whose weight is 3 Kg more than that of D, replaces A, the average weight of B, C, D and E becomes 79 Kg. The weight of A is:

(a) 65 Kg (b) 70 Kg
(c) 75 Kg (d) 80 Kg

**[SSC (GL) Prel. Examination, 2003]**

**21.** The average salary of all the workers in a workshop is ₹8000. The average salary of 7 technicians is ₹12000 and the average salary of the rest is ₹6000. The total number of workers in the workshop is:

(a) 20 (b) 21
(c) 23 (b) 22

**[SSC (GL) Prel. Examination, 2003]**

**22.** The average marks scored by Ganesh in English, Science, Mathematics and History is less than 15 from that scored by him in English, History, Geography and Mathematics. What is the difference of marks in Science and Geography secured by him?

(a) 40 (b) 50
(c) 60 (d) Data inadequate
(e) None of these

**[BSRB Chennai PO, 2000]**

**23.** A Mathematics teacher tabulated the marks secured by 35 students of 8th class. The average of their marks was 72. If the marks secured by Reema was written as 36 instead of 86 then find the correct average marks up to two decimal places.

(a) 73.41 (b) 74.3
(c) 72.43 (d) 73.43
(e) Cannot be determined

**[BSRB Bangalore PO, 2000]**

**24.** The average weight of 8 persons increases by 1.5 Kg. If a person weighting 65 Kg is replaced by a new person, what could be the weight of the new person?

(a) 76 Kg (b) 77 Kg
(c) 76.5 Kg (d) Data inadequate
(e) None of these

**25.** The average of four consecutive even numbers is one-fourth of the sum of these numbers. What is the difference between the first and the last number?

(a) 4 (b) 6
(c) 2 (d) Cannot be determined
(e) None of these

**[BSRB Delhi PO, 2000]**

**26.** Of the three numbers, the average of the first and the second is greater than the average of the second and the third by 15. What is the difference between the first and the third of the three numbers?

(a) 15 (b) 45
(c) 60 (d) Data inadequate
(e) None of these

**[BABARD Asst. Manager Examination, 2002]**

**27.** The average of 25 results is 18, that of first 12 is 14 and of the last 12 is 17. Thirteenth result is:

(a) 72 (b) 78
(c) 85 (d) 28

**[Canara Bank PO, 2003]**

**28.** Average age of seven persons in a group is 30 years. The average age of five persons of this group is 31 years. What is the average age of the other two persons in the group?

(a) 55 years (b) 26 years
(c) 15 years (d) Cannot be determined
(e) None of these

**[PNB Management Trainee Examination, 2003]**

**29.** Average weight of three boys P, T and R is $54\frac{1}{3}$ Kg while the average weight of three boys T, F and G is 53 Kg. What is the average weight of P, T, R, F and H?

(a) 53.8 Kg (b) 52.4 Kg
(c) 53.2 Kg (d) Data inadequate
(e) None of these

**[Bank of Maharashtra, 2003]**

**30.** In a class of 52 students the number of boys is two less than the number of girls. Average weight of the boys is 42 Kg, while the average weight of all the 52 students is 40 Kg. Approximately what is the average weight of the girls?

(a) 41 Kg (b) 29 Kg
(c) 40 Kg (d) 38 Kg
(e) 42 Kg

**[IBPS, 2003]**

**31.** The average of 4 consecutive even numbers a, b, c and d is 45. What is the product of A and C?

(a) 2025 (b) 1842
(c) 1932 (d) 2016

**[OBC PO Examination, 2003]**

**32.** The average of 7 consecutive numbers is 20. The largest of these numbers is:

(a) 24 (b) 23
(c) 22 (d) 20

**[SSC (GL) Prel. Examination, 2000]**

**33.** The average age of 14 girls and their teacher is 15 years. If the teacher's age is excluded, the average reduces by 1 year. What is the teacher's age?

(a) 35 years (b) 32 years
(c) 30 years (d) 29 years

**[SSC (GL) Prel. Examination, 2000]**

**34.** The average age of four brothers is 12 years. If the age of their mother is also included, the average is increased by 5 years. The age of their mother (in years) is:

(a) 37 years (b) 43 years
(c) 48 years (d) 53 years

**[SSC (GL) Prel. Examination, 2000]**

**35.** The average age of A and B is 20 years, that of B and C is 19 years and that of A and C is 21 years. What is the age (in years) of B?

(a) 39 (b) 21
(c) 20 (d) 18

**[SSC (GL) Prel. Examination, 2000]**

**36.** There are in all 10 balls; some of them are red and others are white. The average cost of all balls is ₹28. If the average cost of red balls is ₹25 and that of white balls is ₹30, then the number of white balls is:

(a) 3 (b) 5
(c) 6 (d) 7

**[SSC (GL) Prel. Examination, 2000]**

**37.** The average of marks of 14 students was calculated as 71. But, it was later found that the marks of one student had been wrongly entered as 42 instead of 56 and of another as 74 instead of 32. The correct average is:

(a) 67 (b) 68
(c) 69 (d) 71

**[SSC (GL) Prel. Examination, 2000]**

**38.** Of the four numbers whose average is 60, the first is one-fourth of the sum of the last three. The first number is:

(a) 15 (b) 45
(c) 48 (d) 60.25

**[SSC (GL) Prel. Examination, 2000]**

**39.** Average age of father and his two sons is 27 years. Five years ago, the average age of the two sons was 12 years. If the difference between the ages of the two sons is 4 years, then the present age of the father is:

(a) 34 years (b) 47 years
(c) 64 years (d) 27 years

**[SSC (GL) Prel. Examination, 2000]**

**40.** The average age of 30 boys in a class is 15 years. A boy, aged 20 years, left the class, but two new boys came is his place whose ages differ by 5 years. If the average age of all the boys now in the class becomes 15 years, the age of the younger newcomer is:

(a) 20 years (b) 15 years
(c) 10 years (d) 8 years

**[SSC (GL) Prel. Examination, 2002]**

**41.** Out of three numbers, the first is twice the second and is half of the third. If the average of the three numbers is 56, then difference of first and third numbers is:

(a) 12 (b) 20
(c) 24 (d) 48

**[SSC (GL) Prel. Examination, 2002]**

**42.** Of the three numbers, second is twice the first and is also twice the third. If the average of the three numbers is 44, the largest number is:

(a) 24 (b) 72
(c) 36 (d) 108

**[SSC (GL) Prel. Examination, 2002]**

**43.** The average of 8 men is increased by 2 years when 2 of them whose ages are 21 and 23 years are replaced by two new men. The average age of two new men is:

(a) 22 years (b) 24 years
(c) 28 years (d) 30 years

**[SSC (GL) Prel. Examination, 2002]**

**44.** The average age of A and B is 30 years, that of B and C is 32 years, and the average age of C and A is 34 years. The age of C is:

(a) 33 years (b) 34 years
(c) 35 years (d) 36 years

**[SSC (GL) Prel. Examination, 2002]**

**45.** In a certain year, the average monthly income of a person is ₹3400 and that for the first eight months is ₹3160 and for the last five months is ₹4120. The income in the eight month of the year is:

(a) ₹5080 (b) ₹6080
(c) ₹5180 (d) ₹3880

**[SSC (GL) Prel. Examination, 2003]**

**46.** Average age of six sons of a family is 8 years. Average age of sons together with their parents is 22 years. If the father is older than the mother by 8 years, the age of the mother (in years) is:

(a) 44 (b) 52
(c) 60 (d) 68

**[SSC (GL) Prel. Examination, 2003]**

**47.** A grocer has a sale of ₹6435, ₹6927, ₹6855, ₹7230 and ₹6562 for 5 consecutive months. How much sale must he have in the sixth month so that he gets an average sale of ₹6500?

(a) ₹4991 (b) ₹5991
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**[SSC (GL) Prel. Examination, 2003]**

**48.** The average weight of three men A, B and C is 84 Kg. D joins them and the average weight of the four becomes 80 Kg. If E, whose weight is 3 Kg more than that of D, replaces A, the average weight of B, C, D and E becomes 79 Kg. The weight of A is:

(a) 65 Kg (b) 70 Kg
(c) 75 Kg (d) 80 Kg

**[SSC (GL) Prel. Examination, 2003]**

**49.** The average marks scored by Ganesh in English, Science, Mathematics and History is 15 marks less than what he scored in English, History, Geography and Mathematics. What is the difference of marks in Science and Geography, Ganesh scored?

(a) 40 (b) 50
(c) 60 (d) Data inadequate

**[BSRB Chennai PO, 2000]**

**50.** A Mathematics teacher tabulated the marks scored by 35 students of 8th class. The average of their marks was 72. If the marks scored by Reema was written as 36 instead of 86, then find out the correct average marks (up to two decimal places).

(a) 73.41 (b) 74.3
(c) 72.43 (d) 73.43

**[BSRB Bangalore PO, 2000]**

**51.** The average of four consecutive even numbers is one-fourth of the sum of these numbers. What is the difference between the first and the last number?

(a) 4 (b) 6
(c) 2 (d) Cannot be determined

**[BSRB Delhi PO, 2000]**

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(a) 15 (b) 45
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(a) 55 years (b) 26 years
(c) 15 years (d) None of these

**[PNB Management Trainee Examination, 2003]**

**55.** Average weight of three boys P, T and R is $54\frac{1}{3}$ Kg while the average weight of three boys T, F and G is 53 Kg. What is the average weight of P, T, R, F and H?

(a) 53.8 Kg (b) 52.4 Kg
(c) 53.2 Kg (d) Data inadequate

**[Bank of Maharashtra, 2003]**

**56.** In a class of 52 students, the number of boys is two less than the number of girls. Average weight of the boys is 42 Kg, while the average weight of all the 52 students is 40 Kg. Approximately, what is the average weight of the girls?

(a) 41 Kg (b) 29 Kg
(c) 40 Kg (d) 38 Kg

**[IBPS, 2003]**

**57.** The average of three consecutive odd numbers is 12 more than one-third of the first of these numbers. What is the last of the three numbers?

(a) 15 (b) 17
(c) 19 (d) Data inadequate

**[SSC (GL), 2011]**

**58.** Out of four numbers, whose average is 60, the first one is one-fourth of the sum of the last three. The first number is:

(a) 15 (b) 45
(c) 48 (d) 60

**[SSC (GL), 2011]**

**59.** There are three baskets of fruits. The 1st basket has twice the number of fruits in the 2nd basket. The 3rd basket has three-fourths of the fruits in the first. The average of the fruits in all the baskets is 30. What is the number of fruits in the first basket?

(a) 20 (b) 30
(c) 35 (d) 40

**[SSC (GL), 2011]**

**60.** The average weight of 45 students in a class was calculated as 36 Kg. It was later found that the weight of two students in the class was wrongly calculated. The actual weight of one of the boys in the class was 32 Kg, but it was calculated as 34 Kg, and the weight of another boy in the class was 45 Kg, whereas it was calculated as 40 Kg. What is the actual average weight of the 45 students in the class? (Rounded off to two-digits after decimal)

(a) 36.07 Kg (b) 36.16 Kg
(c) 35.84 Kg (d) Cannot be determined

**[PNB PO, 2010]**

**61.** The cost of 5 Kg of apples is ₹450. The cost of 12 dozen mangoes is ₹4320, and the cost of 4 Kg of oranges is ₹240. What is the total cost of 8 Kg of apples, 8 dozens of mangoes and 8 Kg of oranges?

(a) ₹4020 (b) ₹4080
(c) ₹4000 (d) ₹4050

**[PNB PO, 2010]**

**62.** 12% of Kaushal's monthly salary is equal to 16% of Nandini's monthly salary. Suresh's monthly salary is half that of Nandini's monthly salary. If Suresh's annual salary is ₹1.08 lacs. What is Kaushal's monthly salary?

(a) ₹20000 (b) ₹18000
(c) ₹26000 (d) ₹24000

**[CBI (PO), 2010]**

**63.** In a test, a candidate scored 336 marks out of maximum marks '$x$'. If the maximum marks '$x$' were converted into 400 marks, he would have secured 192 marks. What were the maximum marks of the test?

(a) 700 (b) 750
(c) 500 (d) 650

**[Corporation Bank PO, 2009]**

**64.** The average marks in Science subject of a class of 20 students is 68. If the marks of two students were misread as 48 and 65 of the actual marks 72 and 61, respectively, then what would be the correct average?

(a) 68.5 (b) 69
(c) 69.5 (d) 70

**[Corporation Bank PO, 2009]**

**65.** The average age of the family of 5 members is 24. If the present age of youngest member is 8 years, then what was the average age of the family at the time of the birth of the youngest member?

(a) 20 years (b) 16 years
(c) 12 years (d) 18 years

**[Corporation Bank PO, 2009]**

**66.** In a family, the average age of a father and a mother is 35 years. The average age of the father, mother and their only son is 27 years. What is the age of the son?

(a) 12 years (b) 11 years
(c) 10.5 years (d) 10 years

**[SSC (GL), 2010]**

**67.** The average marks in English subject of a class of 24 students is 56. If the marks of three students were misread as 44, 45 and 61 of the actual marks 48, 59 and 67, respectively, then what would be the correct average?

(a) 56.5 (b) 59
(c) 57.5 (d) None of these

**[IBPS Bank PO, 2011]**

**68.** The sum of five numbers is 290. The average of the first two numbers is 48.5 and the average of last two numbers is 53.5. What is the third number?

(a) 72 (b) 84
(c) 96 (d) None of these

**[IOB PO, 2009]**

**69.** The average of the first 100 positive integers is:

(a) 100 (b) 51
(c) 50.5 (d) 49.5

**[SSC (GL), 2010]**

**70.** The average contribution of 5 men to a fund is ₹35. A sixth man joins and pays ₹35 more than the resultant average of 6 men. The total contribution of all the six men is:

(a) ₹210 (b) ₹245
(c) ₹250 (d) ₹252

**[UPPCS, 2012]**

**71.** Sum of eight consecutive numbers of Set A is 376. What is the sum of 5 consecutive numbers of another set if its minimum number is 15 ahead of average of Set A?

(a) 296 (b) 320
(c) 324 (d) 284

**[Union Bank of India PO, 2011]**

**72.** In a class, the average height of 35 girls was measured 160 cm. Later, on it was discovered that height of one of the girls was misread as 144 cm, while her actual height was 104 cm. What was the actual average height of the girls in the class? (rounded off to two digits after decimal)

(a) 159.86 cm (b) 158.54 cm
(c) 159.56 cm (d) None of these

**[Syndicate Bank PO, 2010]**

**73.** The frequency distribution date is given below. If the average age is 17 years, the value of m is Age (in years):8202629.
Number of people: 32 m 1

(a) 1 (b) 2
(c) 3 (d) 4

**[SSC, 2014]**

**74.** The average monthly expenditure of a family for the first four months is ₹2570, for the next three months ₹2490 and for the last five months ₹3030. If the family saves ₹5320 during the whole year, the average monthly income of the family during the year is:

(a) ₹3000 (b) ₹3185
(c) ₹3200 (d) ₹3580

**[SSC, 2014]**

**75.** A man spends ₹1800 monthly on an average for the first four months and ₹2000 monthly for the next eight months and saves ₹5600 a year. His average monthly income is:

(a) ₹2000 (b) ₹2200
(c) ₹2400 (d) ₹2600

**[SSC, 2014]**

**76.** The arithmetic mean of the following numbers is 1, 2, 2, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 5, 6, 6, 6, 6, 6, 6, 7, 7, 7, 7, 7, 7, 7

(a) 4 (b) 5
(c) 14 (d) 20

**[SSC, 2014]**

**77.** The average of six numbers is 20. If one number is removed, the average becomes 15. What is the number removed?

(a) 5 (b) 35
(c) 112 (d) 45

**[SSC, 2014]**

**78.** The average of first three numbers is double of the fourth number. If the average of all the four numbers is 12, find the 4th number.

(a) 16 (b) $\frac{48}{7}$
(c) 20 (d) $\frac{18}{7}$

**[SSC, 2013]**

**79.** If the average of 6 consecutive even numbers is 25, the difference between the largest and the smallest number is:

(a) 18 (b) 10
(c) 12 (d) 14

**[SSC, 2013]**

**80.** The arithmetic mean of 100 observations is 24.6 is added to each of the observations and, then each of them is multiplied by 2.5. Find the new arithmetic mean.

(a) 30 (b) 75
(c) 35 (d) 60

**[SSC, 2013]**

**81.** Sachin Tendulkar has a certain average for 11 innings. In the 12th innings he scores 120 runs and thereby increases his average by 5 runs. His new average is:

(a) 60 (b) 62
(c) 65 (d) 66

**[SSC, 2013]**

**82.** The average of 11 results is 50. If the average of the first six results is 49 and that of the last six is 52. The sixth result is:

(a) 48 (b) 50
(c) 52 (d) 56

**[SSC, 2013]**

**83.** There are two groups A and B of a class, consisting of 42 and 28 students, respectively. If the average weight of group A is 25 Kg and that of group B is 40 Kg, find the average weight of the whole class.

(a) 69 (b) 31
(c) 70 (d) 30

**[SSC Assistant Grade III, 2013]**

**84.** The average monthly salary of all the employees in an industry is ₹12,000. The average salary of male employees is₹15,000 and that of female employees is ₹8,000. What is the ratio of male employees to female employees?

(a) 5:2 (b) 3:4
(c) 4:3 (d) 2:5

**[SSC Assistant Grade III, 2013]**

**85.** The sum of five consecutive integers is $a$ and the sum of next five consecutive integers is $b$. Then $\frac{(b-a)}{100}$ is equal to:

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) 3 (d) 2

**[SSC Assistant Grade III, 2012]**

**86.** Ten years ago the average age of P and Q was 20years. Average age of P, Q and R is 30 yearsnow. After 10 years, the age of R will be:

(a) 35 years (b) 40 years
(c) 30 years (d) 45 years

**[SSC Assistant Grade III, 2012]**

**87.** The average value of the numbers 15, 21,32, 35, 46, $x$, 59, 65, 72 should be greater than or equal to 43 but less than or equal to 44. Then the value of $x$ should be:

(a) $42 \le x \le 51$ (b) $43 \le x \le 50$
(c) $42 < x \le 49$ (d) $43 < x < 50$

**[SSC Assistant grade III, 2012]**

**88.** 5 members of a team are weighed consecutively and their average weight calculated after each member is weighed. If the average weight increases by one Kg each time, how much heavier is the last player than the first one?

(a) 4 Kg (b) 20 Kg
(c) 8 Kg (d) 5 Kg

**[SSC, 2012]**

**89.** Out of nine persons, 8 persons spent ₹30 each for their meals. The ninth one spent ₹20 more than the average expenditure of all the nine. The total money spent by all of them was:

(a) ₹260 (b) ₹290
(c) ₹292.50 (d) ₹400.50

**[SSC, 2012]**

**90.** In a school with 600 students, the average age of the boys is 12 years and that of the girls is 11 years. If the average age of the school is 11 years and 9 months, then the number of girls in the school is:

(a) 450 (b) 150
(c) 250 (d) 350

**[SSC, 2012]**

**91.** The mean of 100 items was 46. Later on it was discovered that an item 16 was misread as 61 and another item 43 was misread as 34. It was also found that the number of items was 90 and not 100. Then what is the correct mean?

(a) 50 (b) 50.7
(c) 52 (d) 52.7

**[SSC, 2012]**

**92.** Average rainfall on Monday, Tuesday, Wednesday and Thursday is 420.5 cm and average on Tuesday, Wednesday, Thursday and Friday is 440.5 cm. If the ratio of rainfall for Monday and Friday is 20:21, find the rainfall in cm on Monday and Friday.

(a) 1800, 1890 (b) 1600, 1680
(c) 1700, 1470 (d) 1682, 1762

**[SSC, 2012]**

**93.** The average of 5 consecutive integers starting with '$m$' is $n$. What is the average of 6 consecutive integers starting with $(m + 2)$?

(a) $\frac{2n+5}{2}$ (b) $(n + 2)$
(c) $(n + 3)$ (d) $\frac{2n+9}{2}$

**[SSC, 2012]**

**94.** The batting average for 40 innings of a cricketer is 50 runs. His highest score exceeds his lowest score by 172 runs. If these two innings are excluded, the average of the remaining 38 innings is 48 runs. The highest score of the player is:

(a) 165 (b) 170
(c) 172 (d) 174

**[SSC, 2011]**

**95.** The average of three numbers is 154. The first number is twice the second and the second number is twice the third. The first number is:

(a) 264 (b) 132
(c) 88 (d) 66

**[SSC, 2011]**

**96.** The average salary of all the staff in an office of a corporate house is ₹5,000. The average salary of the officers is ₹14,000 and that of the rest is ₹4,000. If the total number of staff is 500, the number of officers?

(a) 10 (b) 15
(c) 25 (d) 50

**[SSC, 2011]**

**97.** The average marks of 40 students in an English exam is 72. Later it is found that three marks 64, 62 and 84 were wrongly entered as 68, 65 and 73. The average after mistakes were rectified is:

(a) 70 (b) 72
(c) 71.9 (d) 72.1

**[SSC, 2011]**

**98.** Of three numbers, the second is thrice the first and the third number is three-fourths of the first.If the average of the three numbers is 114, the largest number is:

(a) 72 (b) 216
(c) 354 (d) 726

**[SSC, 2011]**

**99.** A batsman, in his 12th innings, makes a score of 63 runs and thereby increases his averagescore by 2. The average of his score after 12 thinnings is:

(a) 41 (b) 42
(c) 34 (d) 35

**[SSC, 2010]**

**100.** The average of two numbers A and B is 20, that of B and C is 19 and of C and A it is 21. What is the value of A?

(a) 24 (b) 22
(c) 20 (d) 18

**[SSC, 2010]**

**101.** A professional institute's total expenditure on students for a particular course is partly fixed and partly varies linearly with the number of students. The average expenseper student is ₹615 when there are 24 students and ₹465 when there are 40 students. What is the average expense when there are 60 students?

(a) ₹370 (b) ₹450
(c) ₹350 (d) ₹420
(e) ₹390

**[IBPS PO/MT, 2014]**

**102.** The average marks in English of a class of 24 students is 56. If the Marks of three students were misread as 44, 45 and 61 in lieu of the actual marks 48, 59 and 67 respectively, then what would be the correct average?

(a) 56.5 (b) 59
(c) 57.5 (d) 58
(e) None of these

**[IBPS PO/MT, 2011]**

**103.** In an entrance examination, Ritu scored 56 percent marks, Smita scored 92 percent marks and Rina scored 634 marks. The maximum marks of the examination is 875. What is the average marks scored by all the three girls together?

(a) 1929 (b) 815
(c) 690 (d) 643
(e) None of these

**[IBPS PO/MT, 2011]**

**104.** The sum of five numbers is 260. The average of the first two numbers is 30 and the average of the last two numbers is 70. What is the third number?

(a) 33 (b) 60
(c) 75 (d) Cannot be determined
(e) None of these

**[Andhra Bank PO, 2011]**

**105.** A, B, C and D are four consecutive odd numbers andtheir average is 42. What is the product of B and D?

(a) 1860 (b) 1890
(c) 1845 (d) 1677
(e) None of these

**[Andhra Bank PO, 2011]**

**106.** The average score of Rahul, Manish and Suresh is 63. Rahul's score is 15 less than Ajay and 10 more than Manish. If Ajay scored 30 marks more than the average score of Rahul, Manish and Suresh, what is the sum of Manish's and Suresh's scores?

(a) 120 (b) 111
(c) 117 (d) Cannot be determined
(e) None of these

**[Corporation Bank PO, 2011]**

**107.** The average age of 80 boys in a class is 15. The average age of a group of 15 boys in the class is 16 and the average age of another 25 boys in the class

is 14. What is the average age of the remaining boys in the class?

(a) 15.25 (b) 14
(c) 14.75 (d) Cannot be determined
(e) None of these

**[Corporation Bank PO, 2010]**

**108.** The total marks obtained by a student in Physics, Chemistry and Mathematics together is 120 more than the marks obtained by him in Chemistry. What is the average marks obtained by him in Physics and Mathematics together?

(a) 60 (b) 120
(c) 40 (d) Cannot be determined
(e) None of these

**[Allahabad Bank PO, 2010]**

**109.** The sum of 5 numbers is 924. The average of the first two numbers is 201.5 and the average of the last two numbers is 196. What is the third number?

(a) 133 (b) 129
(c) 122 (d) Cannot be determined
(e) None of these

**[NABARD Bank Officer, 2009]**

**110.** The average marks in Science subject of a class of 20 students is 68. If the marks of two students were misread as 48 and 65 instead of the actual marks 72 and 61 respectively, what would be the correct average?

(a) 68.5 (b) 69
(c) 69.5 (d) 70
(e) 66

**[Corporation Bank PO, 2009]**

**111.** What is the age of a class teacher?

**I.** There are 11 students in the class.
**II.** The average age of the students and the teacher is 14 years.
**III.** The average age of the teacher and the students is 3 years more than that of the students.

(a) Both I and III
(b) Both I and II
(c) II and either I or III
(d) All I, II and III
(e) None of these

**[IBPS PO/MT, 2013]**

## ANSWER KEYS3

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (c) | **3.** (b) | **4.** (d) | **5.** (c) | **6.** (d) | **7.** (a) | **8.** (a) | **9.** (b) | **10.** (c) | **11.** (c) | **12.** (b) | **13.** (a) |
| **14.** (a) | **15.** (a) | **16.** (d) | **17.** (c) | **18.** (d) | **19.** (a) | **20.** (c) | **21.** (b) | **22.** (a) | **23.** (c) | **24.** (c) | **25.** (c) | **26.** (c) |
| **27.** (c) | **28.** (b) | **29.** (b) | **30.** (b) | **31.** (c) | **32.** (b) | **33.** (c) | **34.** (c) | **35.** (d) | **36.** (a) | **37.** (c) | **38.** (a) | **39.** (a) |
| **40.** (c) | **41.** (c) | **42.** (d) | **43.** (a) | **44.** (d) | **45.** (c) | **46.** (c) | **47.** (c) | **48.** (b) | **49.** (d) | **50.** (a) | **51.** (b) | **52.** (b) |
| **53.** (a) | **54.** (d) | **55.** (c) | **56.** (d) | **57.** (d) | **58.** (a) | **59.** (c) | **60.** (b) | | | | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (d) | **2.** (b) | **3.** (b) | **4.** (c) | **5.** (e) | **6.** (c) | **7.** (b) | **8.** (a) | **9.** (b) | **10.** (c) | **11.** (a) | **12.** (d) | **13.** (e) |
| **14.** (d) | **15.** (c) | **16.** (b) | **17.** (d) | **18.** (a) | **19.** (a) | **20.** (c) | **21.** (b) | **22.** (c) | **23.** (d) | **24.** (b) | **25.** (b) | **26.** (e) |
| **27.** (b) | **28.** (e) | **29.** (d) | **30.** (d) | **31.** (c) | **32.** (b) | **33.** (d) | **34.** (a) | **35.** (d) | **36.** (c) | **37.** (c) | **38.** (c) | **39.** (b) |
| **40.** (b) | **41.** (d) | **42.** (b) | **43.** (d) | **44.** (d) | **45.** (a) | **46.** (c) | **47.** (a) | **48.** (c) | **49.** (c) | **50.** (d) | **51.** (b) | **52.** (d) |
| **53.** (b) | **54.** (d) | **55.** (d) | **56.** (d) | **57.** (c) | **58.** (c) | **59.** (d) | **60.** (a) | **61.** (b) | **62.** (d) | **63.** (a) | **64.** (b) | **65.** (b) |
| **66.** (b) | **67.** (d) | **68.** (d) | **69.** (c) | **70.** (d) | **71.** (b) | **72.** (d) | **73.** (a) | **74.** (b) | **75.** (c) | **76.** (b) | **77.** (d) | **78.** (b) |
| **79.** (b) | **80.** (b) | **81.** (c) | **82.** (d) | **83.** (b) | **84.** (c) | **85.** (a) | **86.** (b) | **87.** (a) | **88.** (c) | **89.** (c) | **90.** (b) | **91.** (b) |
| **92.** (b) | **93.** (a) | **94.** (d) | **95.** (a) | **96.** (d) | **97.** (d) | **98.** (b) | **99.** (a) | **100.** (b) | **101.** (e) | **102.** (e) | **103.** (d) | **104.** (b) |
| **105.** (c) | **106.** (b) | **107.** (a) | **108.** (d) | **109.** (a) | **110.** (b) | **111.** (d) | | | | | | |

# EXPLANATORY ANSWERS

## EXERCISE-1

**1.** **(c)** Total earning for 7 days
$= ₹(60 + 65 + 70 + 52.50 + 63 + 73 + 68)$
$= ₹451.50$
Average daily earning $= ₹\frac{451.50}{7} = ₹64.50$.

**2.** **(c)** The average of 10 numbers = 7
Total of 10 numbers $= 10 \times 7 = 70$
New total of 10 numbers after each of given numbers is multiplied by $8 = 70 \times 8 = 560$
$\therefore$ New average $= \frac{560}{10} = 56$.

**3.** **(b)** Average weight of 5 persons = 38 Kg
$\therefore$ Total weight of these five persons
$= 38 \times 5 = 190$ Kg
Now, average weight of (the boat + 5 persons)
= 52 Kg
$\therefore$ Total weight of (the boat + 5 persons)
$= 52 \times 6 = 312$ Kg
$\therefore$ Weight of the boat $= 312 - 190 = 122$ Kg.

**4.** **(d)** Let, the original expenditure $= ₹x$
Original average expenditure $= \frac{x}{35}$
New average expenditure $= \frac{x+42}{42}$
$\Rightarrow \frac{x}{35} - \frac{x+42}{42} = 1 \Rightarrow x = 420$
$\therefore$ Original expenditure = ₹420.

**5.** **(c)** Average daily maximum temperature
$= \frac{42.7+44.6+42.0+39.1+43.0+42.5+38.5}{7}$
$= \frac{292.4}{7} = 41.77°C$.

**6.** **(d)** Let, the total number of workers be $x$.
$\Rightarrow 850 \times x = 7 \times 1000 + (x - 7) \times 780 \Rightarrow x = 22$.

**7.** **(a)** The total time taken can be calculated as shown below:

| *Distance* | *Speed* | *Time* |
|---|---|---|
| 2500 Km | 500 Km/h | 5 hrs |
| 1200 Km | 400 Km/h | 3 hrs |
| 500 Km | 250 Km/h | 2 hrs |
| Total 4200 Km | | 10 hrs |

Average speed $= \frac{4200}{10} = 420$ Km/h

**8.** **(a)** Marks scored by 2 students $= 100 \times 2 = 200$
Marks scored by 3 students $= 3 \times 0 = 0$
Marks scored by 15 students $= 15 \times 40 = 600$
$\therefore$ Marks scored by 20 students
$= 200 + 0 + 600 = 800$
$\therefore$ Average marks $= \frac{800}{20} = 40$.

**9.** **(b)** Average weight of 24 students of section $A$ = 58 Kg
Total weight of 24 students of section $A = 58 \times 24 =$ 1392 Kg
Average weight of 26 students of section $B$ = 60.5 Kg
Total weight of 26 students of section $B = 60.5 \times 26 =$ 1573 Kg
Total weight of 50 students = (1392 + 1573) Kg
= 2965 Kg
Average weight of the students in the class
$= \frac{2965}{50} = 59.3$ Kg.

**10.** **(c)** Total age of 5 members $= 21 \times 5 = 105$ years.
Total age of 4 members at the birth of the younger member, that is, 5 years ago
$= 105 - (5 \times 5) = 80$ years
Before the birth of the youngest member, the family consisted of only 4 members.
Average age of 4 members 5 years ago
$= \frac{80}{4} = 20$ years.

**11.** **(c)** Sum of seven numbers $= 7 \times 5 = 35$
Sum of first six numbers $= 6 \times 4 = 24$
Therefore, the seventh number $= 35 - 24 = 11$.

**12.** **(b)** Present average age of 5 members
$= 27 + 3 = 30$ years
Sum of present age of 5 members
$= 30 \times 5 = 150$ years
Let, the present age of the child be $x$ years.
Present average age of 6 members
$= \frac{150+x}{6}$ and this is equal to 27 years.
So, $\frac{150+x}{6} = 27$
or, $x = 27 \times 6 - 150$ or, $x = 12$ years.

**13.** **(a)** Weight of the new student
$= 50 + 10 \times 112 = 55$ Kg.

**14.** **(a)** Average salary of 9 persons = ₹2450
Total salary of 9 persons
$= ₹2450 \times 9 = ₹2650$
Total salary of the person who is transferred
= ₹2650

Thus, the total salary of remaining 8 persons

= ₹22050 − ₹2650 = ₹19400

The average salary of the remaining 8 persons

= ₹ $\dfrac{19400}{8}$ = ₹2425.

**15.** **(a)** The mean marks of 10 boys = 70%

Total marks of 10 boys = 70% × 10 = 700%

The mean marks of 15 girls = 60%

Total marks of 15 girls = 60% × 15 = 900%

∴ Sum of the total marks of 25 students

= 700 + 900 = 1600%

∴ The mean marks of all the 25 students

= $\dfrac{1600}{25}$ = 64%

**16.** **(d)** Income for 6th day in rupees

= 15 × 70 − 5 × 60 − 9 × 80 = 30.

**17.** **(c)** The five even consecutive numbers are 4, 6, 8, 10 and 12

Their average $= \dfrac{4+6+8+10+12}{5} = \dfrac{40}{5} = 8.$

**18.** **(d)** Present age of 5 members

= (5 × 17 + 3 × 5) years.

= 100 years.

Present age of 5 members and a baby

= 17 × 6 = 102 years.

∴ Age of the baby = (102 − 100) years.

= 2 years.

**19.** **(a)** Sum of first nine numbers + sum of last nine numbers = 10.5 × 9 + 11.4 × 9 = 21.9 × 9 = 197.1

Hence, the middle number

= 197.1 − 17 × 10.9

= 197.1 − 185.3 = 11.8.

**20.** **(c)** To improve his average by 5 runs per innings he has to contribute 12 × 5 = 60 runs for the previous 12 innings. Thus, the average after the 13th innings

= 96 − 60 = 36.

**21.** **(b)** Average score before 17th innings

= 85 − 3 × 17 = 34

∴ Average score after 17th innings

= 34 + 3 = 37.

**22.** **(a)** Let, the numbers be $x$, $y$ and $z$. Then,

$x + y + z = 98,\ \dfrac{x}{y} = \dfrac{2}{3}$ and $\dfrac{y}{z} = \dfrac{5}{8}$

∴ $x = \dfrac{2y}{3}$ and $z = \dfrac{8y}{5}$

So, $\dfrac{2y}{3} + y + \dfrac{8y}{5} = 98$

or, $\dfrac{49y}{15} = 98$ or, $y = 30$.

**23.** **(c)** The sailor weighing 56 Kg is replaced and the average is increased by 1 Kg. Hence, the weight of the new sailor is (56 + increase in total weight) = 56 + 1 × 8

= 56 + 8 = 64 Kg.

**24.** **(c)** Average of 5, 7, 14 and $y = \dfrac{5+7+14+y}{4}$

Therefore, $x$ = 80% of $\dfrac{5+7+14+y}{4} = \dfrac{80}{100} \times \dfrac{26+y}{4}$

$\Rightarrow\ x = \dfrac{26+y}{5}$ (1). Also $\dfrac{x+y}{2} = 26$ (2)

From, (1) and (2), we get $52 - y = \dfrac{26+y}{5} \Rightarrow y = 39.$

**25.** **(c)** Present age of $x$

= [(49 × 5) − (4 × 45 + 4 × 5)] years

= 45 years.

**26.** **(c)** Let, the rainfall on Wednesday be $x$ cm so that on the other 6 days, the total is also $x$.

Since average rainfall for the week = 3 cm

∴ $x + x = 3 \times 7$ or, $x = 10.5$ cm.

**27.** **(c)** Average monthly expenditure of 4 months

= ₹2700

Total expenditure for 4 months = ₹2700 × 4

= ₹11000

Average monthly expenditure of 3 months

= ₹2940

Total expenditure for 3 months = ₹2940 × 5

= ₹8820 ···(1)

Average monthly expenditure of 5 months

= ₹3130

Total expenditure of 5 months = ₹31020

= ₹1560 ···(2)

Total expenditure in the whole year

= ₹11000 + 8820 + ₹15650

= ₹35470.

Saving during the whole year = ₹5330

Total income of the family during the year

= ₹35470 + ₹5330 = ₹40800

∴ Average monthly income during the year

= $\dfrac{40800}{12}$ = ₹3400.

**28.** **(b)** Let, the average age of 8 men be $x$ years.

∴ Sum of the ages of 8 men = 84 years.

Now, according to the condition of the question, average age of (6 men + 2 women) = ($x$ + 2) years.

∴ Sum of the ages of (6 men + 2 women)

= $8(x + 2) = 8x + 16$ years

Hence, it is clear that on replacing 2 men by 2 women, sum of their ages increased by 16 years.

Therefore, sum of the ages of two women

= (20 + 24) + 16 = 60 years

$\therefore$ Average age of the women = $\frac{60}{2}$ = 30 years.

**29.** **(b)** Average of the remaining set of numbers

$= \frac{50 \times 38 - (45 + 55)}{50 - 2} = \frac{1900 - 100}{48} = 37.5.$

**30.** **(b)** Time taken to cover first 100 kilometres

$= \frac{100}{30} = 3\frac{1}{3}$ hrs

Time taken to cover second 100 kilometres

$= \frac{100}{40} = 2\frac{1}{2}$ hrs

Time take to cover last 100 kilometres

$= \frac{100}{50} = 2$ hrs

Total time taken $= 3\frac{1}{3} + 2\frac{1}{2} + 2 = \frac{10}{3} + \frac{5}{2} + 2$

$= \frac{47}{6}$ h

Total distance covered = 300 Km

$\therefore$ Average speed $= \frac{300}{47/6} = \frac{300 \times 6}{47} = 38.3$ Km/h.

**31.** **(c)** Seventh observation

= 7 × 11 − 6 × 12 = 5.

**32.** **(b)** Average age of the five new boys

= (25 × 15.56 − 20 × 15.6) ÷ 5

= 15.4 years,

**33.** **(c)** Weight of D = (80 × 4 − 84 × 3) Kg = 68 Kg

Weight of E = (68 + 3) Kg = 71 Kg

(B + C + D + E)'s weight = (79 × 4) Kg = 316 Kg

$\therefore$ (B + C)'s weight = [316 − (68 + 71)] Kg

= 177 Kg

Hence, A's weight = [(84 × 3) − 177] Kg = 75 Kg.

**34.** **(c)** Let, ₹$x$ be the average expenditure for 30 boarders.

$\therefore$ $30x + 40 = (x - 2) \times 40$ or, $x = 12$

Hence, actual expenditure = ₹12 × 30 = ₹360.

**35.** **(d)** Let, the numbers be $2x$, $x$ and $\frac{x}{3}$.

Then, average $= \frac{2x + x + \frac{x}{3}}{3} = 10 \Rightarrow \frac{9x + x}{3 \times 3} = 10$

or, $\frac{10x}{9} = 10$, or, $x = 9$

Hence, the numbers are 18, 9 and 3.

**36.** **(a)** Correct average

$= \frac{50 \times 36 - 73 + 37}{36}$

$= \frac{1764}{36} = 49$ Kg.

**37.** **(c)** Total earning for the week

= ₹(4 × 18 + 4 × 22 − 20) = ₹140

$\therefore$ Average earning = ₹ $\frac{140}{7}$ = ₹20.

**38.** **(a)** Let, the number of candidates who passed = $x$.

Then, $39 \times x + 15 \times (120 - x) = 120 \times 35$

$\therefore$ $24x = 4200 - 1800$

or, $x = \frac{2400}{24}$

$x = 100$.

**39.** **(a)** Total decrease = (20 × 2) months

= 3 years 4 months

$\therefore$ Age of the new boy = 18 years − 3 years 4 months

= 14 years 8 months.

**40.** **(c)** Temperature on Monday + Tuesday + Wednesday + Thursday = 4 × 48° = 192°

Temperature on Monday = 42°

$\therefore$ Tuesday + Wednesday + Thursday

= (192° − 42°) = 150°

Temperature on Tuesday + Wednesday + Thursday + Friday = 4 × 52° = 208°

$\therefore$ Friday's temperature = 208° − 150° = 58°.

**41.** **(c)** Total spending in 12 months

= ₹[269.47 × 7 + 281.05 × 5]

= ₹3291.54

Total income = spendings + savings

= ₹3291.54 + ₹308.46

= ₹3600.00

$\therefore$ Monthly salary = ₹ $\frac{3600}{12}$ = ₹300.

**42.** **(d)** Let, the numbers be $x$ and $y$, $x < y$.

Then, $x + y = 124$; $\frac{x + 2}{y} = \frac{1}{2} \Rightarrow y = 2x + 4$.

Solving the above equations, we get

$y = 84$, $x = 40$.

**43.** **(a)** $\frac{(x + 2) \times 60 + x \times 120 + (x - 2) \times 180}{x + 2 + x + x - 2} = 100$

$\therefore$ $x = 4$.

**44.** **(d)** Let, temperature on the 4th day be $x$°C

$\therefore$ $4 \times 38.6 + 4 \times 40.3 - x = 7 \times 39.1$

or, $x = 41.9$

$\therefore$ Temperature on the 4th day = 41.9°C.

**45.** **(c)** Let, daily wages of C = $x$.

Then, daily wages of A = $2x$

and, daily wages of B = $x + 40$

Hence, average daily wages of A, B and C

$= \frac{x + 2x + x + 40}{3} = \frac{4x + 40}{3}$

$\therefore\quad \frac{4x+40}{3} = 120$ or, $4x + 40 = 360$

$\Rightarrow\quad 4x = 320$ or, $x = 80$

$\therefore$ Daily wages of A = 2 × 80 = ₹160.

**46.** **(c)** $\frac{x}{35} - \frac{x}{40} = \frac{15}{60}$ or, $\frac{5x}{35 \times 40} = \frac{1}{4}$

or, $x = \frac{35 \times 40}{5 \times 4} = 70$

$\therefore$ Total journey = 70 Km.

**47.** **(c)** Let, the number of candidates be $x$. Then, total marks obtained by all the candidates = $45x$.

Marks reduced for 90 candidates = 30 × 90 = 2700

Total reduced marks = $45x - 2700$.

Reduced average = $\frac{45x - 2700}{x}$.

$\therefore\quad 40 = \frac{45x - 2700}{x}$ or, $40x = 45x - 2700$

$\Rightarrow\quad 5x = 2700$ or, $x = 540$.

**48.** **(b)** Let, attendance on first, second and third day be 2, 5 and 13, respectively.

Total number of visitors for three days = 2 + 5 + 13 = 20

Total amount of money collected

= 2 × 15 + 5 × 7.50 + 13 × 2.50

= 30 + 37.5 + 32.5 = 100

Average charge per person = $\frac{100}{20} = 5$.

**49.** **(d)** Total profit for 30 days = 30 × 350

= ₹10500

Profit for the first 15 days = 15 × 275 = ₹4125

$\therefore$ Profit for the last 15 days = ₹10500 – 4125 = ₹6375

Average profit for the last 15 days = ₹ $\frac{6375}{15}$ = ₹425.

**50.** **(a)** Let, the number of wickets taken before the last match = $x$.

Then, $\frac{12.4x + 26}{x+5} = x \Rightarrow x = 85$.

**51.** **(b)** Let, the numbers be $2x$, $x$ and $4x$.

Average = $\frac{2x + x + 4x}{3} \Rightarrow \frac{7x}{3} = 56$.

$\therefore\quad x = \frac{3 \times 56}{7} = 24$.

Hence, the numbers in order are 48, 24 and 96.

**52.** **(b)** Suppose, the average expenditure was ₹$x$.

Then, total expenditure = $35x$.

When 7 more students join the mess, total expenditure = $35x + 42$

Now, the average expenditure

$= \frac{35x + 42}{35 + 7} = \frac{35x + 42}{42}$

Now, we have $\frac{35x + 42}{42} = x - 1$

$\therefore\quad x = 12$

Thus, the actual expenditure of the mass

= 35 × 12 = ₹420.

**53.** **(a)** Sum total of 50 numbers = 50 × 38 = 1900

Sum total of the remaining 48 numbers

= 1900 – (45 + 55) = 1800

$\therefore$ Average = $\frac{1800}{48} = 37.5$.

**54.** **(d)** Average weight of 11 boys is increased by 100 gm (= 0.1 Kg.)

$\therefore$ Their total increase in weight

= 0.1 × 11 = 1.1 Kg

Hence, the weight of the boy = 42 + 1.1 = 43.1 Kg.

**55.** **(c)** Let, the numbers be $n - 1$, $n$ and $n + 1$. Their average = $n$.

The next two consecutive numbers are $n + 2$ and $n + 3$.

Therefore, the average of the five numbers

$= \frac{(n-1) + n + (n+1) + (n+2) + (n+3)}{5}$

$= \frac{5n+5}{5} = n + 1$.

**56.** **(d)** Total monthly salary of 21 persons

= ₹(21 × 2000) = ₹42000

Total monthly salary of 20 persons

= ₹(20 × 1900) = ₹38000

Monthly salary of the manager = ₹4000

Annual salary of the manager = ₹48000.

**57.** **(d)** Let, the number of boys be $x$ and the number of girls be $y$.

Sum of ages of boys = $16.4x$

Sum of ages of girls = $15.4y$

The average age of all the students

$= \frac{16.4x + 15.4y}{x + y} = 15.8$

$\Rightarrow\quad 16.4x + 15.4y = 15.8x + 15.8y$

or, $16.4x - 15.8x = 15.8y - 15.4y$

or, $0.6x = 0.4y$

or, $\frac{x}{y} = \frac{0.4}{0.6} = \frac{2}{3}$ or $x{:}y = 2{:}3$.

**58.** **(a)** Total expenditure for the first five months

= 5 × 3600 = ₹18000

Total expenditure for the next seven months

= 7 × 3900 = ₹27300

Savings = ₹8700

Total income during the year

= 18000 + 27300 + 8700 = ₹54000

Average income per month = $\frac{54000}{12}$ = ₹4500.

**59.** **(c)** Let, the numbers be $x$, $2x$, $\frac{2}{3}x$.

Average = $\frac{x+2x+\frac{2}{3}x}{3}$ ⇒ $\frac{11x}{9}$ = 44

∴ $x = \frac{44\times 9}{11}$ = 36

So, the numbers are 36, 72 and 24.

Hence, the largest one is 72.

**60.** **(b)** New average of the committee (in years)

$= \frac{8\times 40-55+39}{8} = \frac{320-16}{8}$

$= \frac{304}{8}$

= 38 years.

## Exercise-2
## (Based on Memory)

**1.** **(d)** Correct means = $60 - \frac{75-65}{100} = 59.9$

**2.** **(b)** Let the average of runs made by other 6 batsmen be $x$

∴ Runs made by the captain

= $x$ + 30

∴ $x$ + 60 + 6$x$ = 310

7$x$ = 280

∴ $x$ = 40

∴ Number of runs scored by the captains = 40 + 30 = 70

**3.** **(b)** ∵ $A+B+C+D = A+B+E+F$

$C+D = E+F$

**5.** **(e)** 85

We have, $117 + x + (x+12) + 15 = 72.5\times 4$

[where $x$ is the lower integer among the remaining two integers]

⇒ $2x = 290 - 144$ ∴ $x = 73$

Hence the higher integer (among the remaining two integers) = 73 + 12 = 85

**6.** **(c)** 16$a$ + 16$b$ = 48

or, 16($a$ + $b$) = 48 ∴ $a$ + $b$ = 3

Hence, the required average of $a$ and $b$ $= \frac{3}{2} = 1.5$

**7.** **(b)** We have

$\frac{x+(x+2)+(x+4)+(x+6)}{4} = 65$

∴ $x$ = 62 and $x$ + 6 = 68

Now,

Required value of $x(x + 6)$ = 62 × 68 = 4216

**8.** **(a)** Sum of the last two numbers

= 555 − (72 × 2) − 115 = 290

Thus required average $= \frac{290}{2} = 145$

**9.** **(b)** Age of B = Age of (A + B + C) − Age of (A + C) = 216 × 3 − 29 × 2 = 78 − 58 = 20 years

**10.** **(c)** Suppose the three consecutive even numbers are $x$ − 2, $x$ and $x$ + 2. Then

$(x-2)+x+(x+2) = x+44$

$\Rightarrow 3x = x+44 \quad \therefore x = 22$

∴ largest number = 22 + 2 = 24

**11.** **(a)** Average weight of 10 boys = $\frac{550}{10}$ = 55 Kg

Average weight of 15 girls = 55 − 5 = 50 Kg

∴ Average weight of 10 boys and 15 girls

$= \frac{10\times 15+15\times 50}{25}$ = 52 Kg

**12.** **(d)** Required average

$= \frac{(65\times 14)-(20\times 14+15\times 12)}{65-(20+15)}$

$= \frac{910-460}{30} = \frac{450}{30} = 15$

**13.** **(e)** Total fo five numbers

= 306.4 × 5 = 1532

∴ reqd third no.

= 1532 /0 [(431 × 2) + (214.5 × 2)]

= 1532 − [862 + 429] = 241

**14.** **(d)** Average price per book $\frac{1050+1020}{115}$ = ₹18

**15.** **(c)** Suppose the consecutive odd numbers are $x$ + 1, $x$ + 3, $x$ + 5 and $x$ + 7

Then we have $\frac{(x+1)+(x+3)(x+5)+(x+7)}{4} = 42$

or, 4$x$ +16 = 42 × 4 or, $x$ = 38

Hence, the numbers are 39, 41, 43, and 45.

Now, B × D = 41 × 45 = 1845

**16.** **(b)** Third number

= 260 − (2× 30) − (2 × 70) = 60

**17.** **(d)** The numbers are 43, 45, 47, 49, 51

∴ A × D = 43 × 51 = 2193

**18.** **(a)** Let the number of students be $x$.

$\therefore \quad 6x + 12 \times 40 = 7(x + 12)$

$\Rightarrow \quad 6x + 480 = 7x + 84 \quad \Rightarrow \quad x = 396$

**19.** **(a)** Sale amount of grocer in the sixth month

$= 6 \times 6500 - (6435 + 6927 + 6855 + 7230 + 6562)$

$= 39000 - 34009 =$ ₹4991.

**20.** **(c)** Sum of weights of A, B and C = 84 × 3 Kg = 252 Kg

Weight of D = 4 × 80 − 252 = 320 − 252 = 68 Kg

Weight of E = 68 + 3 = 71 Kg

A + B + C + D = 320

B + C + D + E = 79 × 4 = 316

$\Rightarrow$ A − E = 4 Kg

$\therefore$ A = 4 + E = 4 + 71 = 75 Kg.

**21.** **(b)** By the method of Alligation:

Technicians : Rest

12000 : 6000

8000

1 : 2

Total no. of workers = 7 × 3 = 21.

**22.** **(c)** $\dfrac{E+S+M+H}{4} - \dfrac{E+H+G+M}{4} = 15$

or, $E + S + M + H - E - H - G - M = 60$

$\therefore \quad S - G = 60.$

**23.** **(d)** Correct average $= \dfrac{35 \times 72 + (86 - 36)}{35}$

$\approx 72 + 1.43$

$= 73.43.$

**25.** **(b)** Let the four consecutive even numbers be $2x$, $2x + 2$, $2x + 4$ and $2x + 6$, respectively.

Required difference = $2x + 6 - 2x = 6$.

**26.** **(e)** Let the three numbers be $x$, $y$ and $z$.

or, $\dfrac{x+y}{2} - \dfrac{y+z}{2} = 15$

or, $\dfrac{x+y-y-z}{2} = 15$ or, $x - z = 30$.

**27.** **(b)** Total of 25 results = 25 × 18 = 450

Total of first 12 results = 12 × 14 = 168

Total of last 12 results = 12 × 17 = 204

$\therefore$ Thirteenth result = 450 − 168 − 204 = 78.

**28.** **(e)** Total age of seven persons = 30 × 7 = 210 years.

Total age of five persons = 31 × 5 = 155 years.

$\therefore$ Total age of two persons = (210 − 155) years = 55 years.

$\therefore$ Average age of two persons $= \dfrac{55}{2} = 27.5$ years.

**29.** **(d)** We are to determine the average weight of P, T, R, F and H.

Obviously, this cannot be determined as we do not know the weight of H.

**30.** **(d)** Let number of boys = $x$

and number of girls = $y$

Now, $y - 2 = x$ and $x + y = 52$

$y - 2 + y = 52$

$2y = 54$

$\therefore \quad y = 27 \qquad \therefore \quad x = 25$

Let the average weight of the girls be '$a$'.

Then, $\dfrac{(25 \times 42) + (27 \times a)}{52} = 40$

or, $27 \times a = (52 \times 40) - (25 \times 42)$

or, $27 \times a = 2080 - 1050$

$\therefore \quad a = \dfrac{1030}{27} = 38.148 \approx 38$ Kg.

**31.** **(c)** $\dfrac{x+x+2+x+4+x+6}{4} = 45$

$4x + 12 = 180 \quad 4x = \Rightarrow x = 42$

Product of A and C is

$42 \Rightarrow 46 = 1932$

**32.** **(b)** Let, the 7 consecutive numbers be $x - 3$, $x - 2$, $x - 1$, $x$, $x + 1$, $x + 2$ and $x + 3$

$\therefore \quad \dfrac{(x-3)+(x-2)+(x-1)+x+(x+1)+(x+2)+(x+3)}{7}$

$= 20$

$\Rightarrow \quad \dfrac{7x}{7} = 20 \Rightarrow x = 20$

$\therefore$ largest number = $x + 3 = 20 + 3 = 23$.

**33.** **(d)** Let, the teacher's age be $x$ years

$\therefore \quad \dfrac{15 \times 15 - x}{14} = 14$

$\Rightarrow \quad 225 - x = 196$

$\Rightarrow \quad x = 29.$

**34.** **(a)** Let, the age of the mother be $x$ years

$\therefore \quad \dfrac{14 \times 12 + x}{5} = 17 \Rightarrow x = 37.$

**35.** **(d)** Total age of A and B = 40

Total age of B and C = 38

Total age of A and C = 42

Total age of A + B + C = 60

$\therefore$ Age of B = 60 − 40 = 18.

**36.** **(c)** Total cost of all the balls = ₹280

Let, the number of red balls = $x$

$\therefore$ Number of white balls = $10 - x$

$\therefore \quad 25x + 30(10 - x) = 280$

$\Rightarrow \quad x = 4$

$\therefore$ Number of white balls = 10 − 4 = 6.

**37.** **(c)** Marks obtained by 14 students
$= 14 \times 71 = 994$
Exact marks of 14 students
$= 994 + \{(56 - 42) + (32 - 74)\}$
$= 994 + \{14 + (-42)\} = 994 + \{-28\}$
$= 994 - 28 = 966$
$\therefore$ Correct average $= \dfrac{966}{14} = 69.$

**38.** **(c)** Let, the numbers be $x$, $y$, $z$ and $t$
$\therefore\ x + y + z + t = 240$ and $x = \dfrac{1}{4}(y + z + t)$
$\therefore\ x = 48$
$\therefore$ The first number = 48.

**39.** **(b)** $F + S_1 + S_2 = 81$
$(S_1 - 5) + (S_2 - 5) = 24$
$\Rightarrow S_1 + S_2 = 34$
Also, $S_1 - S_2 = 4$
$\therefore\ S_1 = 19, S_2 = 15$
$\therefore$ Age of the father = 47.

**40.** **(b)** $31 \times 15 - (30 \times 15 - 20) = x + x + 5$
$\therefore\ x = 15$

**41.** **(d)** $2x + x + 4x = 56 \times 3$
$\therefore\ 2x = 48.$

**42.** **(b)** Let, the first number be $x$.
$\therefore$ The second number $= 2x$
and the third number $= \dfrac{2}{3}x$
$\therefore\ \dfrac{x + 2x + \frac{2}{3}x}{3} = 44$ or, $\dfrac{11x}{9} = 44$
$\therefore\ x = 36$
$\therefore$ The second number is the largest $= 2x = 2 \times 36 = 72.$

**43.** **(d)** When 2 new men are replaced, average age is increased by 2 years.
$\therefore$ Increase in the total age of 8 men
$= 8 \times 2 = 16$ years
$\therefore$ Total age of 2 new men
$= 16 + 44 = 60$ years
$\therefore$ Average age of 2 new men
$= \dfrac{60}{2} = 30$ years.

**44.** **(d)** $A + B = 60$, $B + C = 64$, $A + C = 68$
$\therefore\ C - A = 4$, $C + A = 68$
$\Rightarrow\ C = 36$, $A = 32$, $B = 28$.

**45.** **(a)** Income in the eighth month
$= (8 \times 3160 + 5 \times 4120) - (12 \times 3400)$
$= (25280 + 20600 - 40800)$
= ₹5080.

**46.** **(c)** Age of mother + father $= 22 \times 8 - 8 \times 6$
$= 176 - 48$
$= 128$
father − mother = 8
$\therefore$ Age of mother $= \dfrac{128 - 8}{2} = 60$ years.

**47.** **(a)** Sales amount of grocer in the sixth month
$= 6 \times 6500 - (6435 + 6927 + 6855 + 7230 + 6562)$
$= 39000 - 34009$
= ₹4991.

**48.** **(c)** Sum of weights of A, B and C $= 84 \times 3$ Kg
= 252 Kg
Weight of D $= 4 \times 80 - 252$
$= 320 - 252$
= 68 Kg
Weight of E $= 68 + 3$
= 71 Kg
A + B + C + D = 320
B + C + D + E $= 79 \times 4$
= 316
$\Rightarrow$ A − E = 4 Kg
$\therefore$ A = 4 + E = 4 + 71 = 75 Kg.

**49.** **(c)** $\dfrac{E + S + M + H}{4} - \dfrac{E + H + G + M}{4} = 15$
or, $E + S + M + H - E - H - G - M = 60$
$\therefore\ S - G = 60.$

**50.** **(d)** Correct average $= \dfrac{35 \times 72 + (86 - 36)}{35}$
$\approx 72 + 1.43$
$= 73.43.$

**51.** **(b)** Let, the four consecutive even numbers be $2x$, $2x + 2$, $2x + 4$ and $2x + 6$, respectively.
The required difference $= 2x + 6 - 2x = 6.$

**52.** **(d)** Let, the three numbers be $x$, $y$ and $z$.
or, $\dfrac{x + y}{2} - \dfrac{y + z}{2} = 15$
or, $\dfrac{x + y - y - z}{2} = 15$ or, $x - z = 30.$

**53.** **(b)** Total of 25 results $= 25 \times 18 = 450$
Total of first 12 results $= 12 \times 14 = 168$
Total of last 12 results $= 12 \times 17 = 204$
$\therefore$ The 13th result $= 450 - 168 - 204$
= 78.

**54.** **(d)** The total age of 7 person $= 30 \times 7 = 210$ years.
Total age of 5 persons $= 31 \times 5 = 155$ years.
$\therefore$ The total age of 2 persons $= (210 - 155)$ years
= 55 years.
$\therefore$ The average age of two persons $= \dfrac{55}{2} = 27.5$ years.

**55.** **(d)** We are to determine the average weight of P, T, R, F and H.

Obviously, this cannot be determined as we do not know the weight of H.

**56.** **(d)** Let, the number of boys = $x$

and the number of girls = $y$

Now, $y - 2 = x$ and $x + y = 52$

$y - 2 + y = 52$

$2y = 54$

$\therefore \quad y = 27$

$\therefore \quad x = 25$

Let, the average weight of the girls be '$a$'.

Then, $\dfrac{(25 \times 42) + (27 \times a)}{52} = 40$

or, $27 \times a = (52 \times 40) - (25 \times 42)$

or, $27 \times a = 2080 - 1050$

$\therefore \quad a = \dfrac{1030}{27} = 38.148 \approx 38$ Kg.

**57.** **(c)** Let, the smallest number be $x$, then

$\dfrac{x}{3} + 12 = x + 2$

$\Rightarrow \quad \dfrac{x + 36}{3} = x + 2$

$\Rightarrow \quad x + 36 = 3(x + 2)$

$\Rightarrow \quad x + 36 = 3x + 6$

$\Rightarrow \quad 3x - x = 36 - 6$

$\Rightarrow \quad 2x = 30$

$\Rightarrow \quad x = 15$

Hence, the third number = 15 + 4 = 19.

**58.** **(c)** Let, the number be $x$, then

$x = \dfrac{240 - x}{4}$

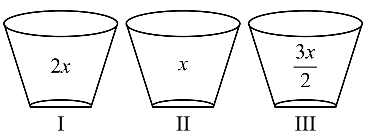
$\Rightarrow \quad 4x = 240 - x$

$\Rightarrow \quad 4x + x = 240$

$\Rightarrow \quad 5x = 240$

$\Rightarrow \quad x = \dfrac{240}{5} = 48.$

**59.** **(d)**




Let, the number of fruits in the second basket be $x$.

Therefore, the number of fruits in the first basket = $2x$.

So, the number of fruits in the third basket

$= 2x \times \dfrac{3}{4} = \dfrac{3}{2}x$

$2x + x + \dfrac{3}{2}x = 30 \times 3$

$\Rightarrow \quad \dfrac{4x + 2x + 3x}{2} = 90$

$\dfrac{9x}{2} = 90$

$9x = 180$

$x = \dfrac{180}{9} = 20$

Hence, the number of fruits in the first basket = $2x = 2 \times 20 = 40$

**60.** **(a)** Average = $\dfrac{(45 \times 36) + 32 - 34 + 45 - 40}{45}$

$= \dfrac{1620 + 3}{45} = 36.07$ kg

**61.** **(b)** Cost of 8 Kg of apples + 8 dozens of mangoes + 8 Kg of oranges

$\dfrac{450}{5} \times 8 + \dfrac{4320}{12} \times 8 + \dfrac{240}{4} \times 8$

720 + 2880 + 480 = ₹4080

**62.** **(d)** Annual salary of Suresh = ₹108000

$\therefore$ Monthly salary = $\dfrac{₹108000}{12}$

= ₹9000

Nandini's monthly salary = ₹18000

According to question,

Kaushal's monthly salary $\times \dfrac{12}{100}$

= Nandini's monthly salary $\times \dfrac{16}{100}$

$K \times \dfrac{12}{100} = ₹18000 \times \dfrac{16}{100}$

$K \times \dfrac{12}{100} = ₹2880$

$K = ₹ \dfrac{2880 \times 100}{12}$

$K = ₹24000$

**63.** **(a)** $x$:336 = 400:192

$x \times 190 = 336 \times 400$

$x = \dfrac{336 \times 400}{192}$

$x = 700$ marks

**64.** **(b)** Difference of marks = 72 + 61 − 48 − 65 = 20.

Correct average marks = $68 + \dfrac{20}{20} = 68 + 1 = 69.$

**65.** **(b)** Total age of the family of five members

= 24 × 5 = 120

Total age of the family of 5 members before 8 years

= 120 − 5 × 8

= 120 − 40 = 80

So, the required average age = $\dfrac{80}{5}$ = 16 years.

**66.** **(b)** Age of the son = 3 × 27 − 2 × 35
= 81 − 70 = 11 years

**67.** **(d)** ∵ Total marks of 24 students = 24 × 56
= 1344

New total marks of 24 students
= 1344 − 44 − 45 − 61 + 48 + 59 + 67 = 1368.

Hence, the required average = $\frac{1368}{24}$ = 57.

**68.** **(d)** The average of first two numbers = 48.5
The average of last two number = 53.5
Sum of five numbers = 290
The third number = $x$
∴ 2 × (48.5) + $x$ + 2 × (53.5) = 290
97 + $x$ + 107 = 290
$x$ = 290 − 204
$x$ = 86

**69.** **(c)** The required average = $\frac{1+2+\cdots 100}{100}$

$= \frac{100\times 101}{2\times 100} = 50.5$

**70.** **(d)** Let, the contribution of the sixth man is ₹$x$, then

$\frac{5\times 35+x}{6} = x - 35$

⇒ 175 + $x$ = 6$x$ − 210
Z 5$x$ = 385
∴ $x$ = 77
∴ Total contribution = ₹(175 + 77)
= ₹252

**71.** **(b)** The average of Set $A$ = $\frac{376}{8}$ = 47.

Minimum number of second set = 47 + 15 = 62
Hence, the required sum = 62 + 63 + 64 + 65 + 66 = 320

**72.** **(d)** $\frac{(35\times 160)-144+104}{35} = \frac{5600-144+104}{35}$

$= \frac{5560}{35} = 158.85$ cm

**Short-cut:** $160 - \frac{144-104}{35} = 158.85$

**73.** **(a)** Required average

$= \frac{8\times 3+20\times 2+26\times m+29\times 1}{3+2+m+1}$

$\Rightarrow \quad 17 = \frac{24+40+26m+29}{6+m}$

$\Rightarrow \quad 17(6+m) = 93+26m$

$\Rightarrow \quad 102+17m) = 93+26m$

$\Rightarrow \quad 26m-17m = 102-93$

$\Rightarrow \quad 9m = 9 \quad \Rightarrow \quad m = 1$

**74.** **(b)** Total annual expenditure of the family
= ₹(4 × 2570 + 3 × 2490 + 5 × 3030)
= ₹(10,280 + 7470 + 15,150) = ₹32,900
Total income
= ₹(32,900 + 5320) = ₹38,220
∴ Required average monthly income

$= ₹\frac{38220}{12} = ₹3185$

**75.** **(c)** Total expenditure of the man in a year
= ₹(4 × 1800 + 8 × 2000)
= ₹(7200 + 16,000) = ₹23,200
Total annual income
= ₹(23,200 + 5600)
= ₹28,800

∴ Average monthly income $= ₹\frac{28800}{12}$
$= ₹2400$

**76.** **(b)** Required mean

$= \frac{1\times 1+2\times 2+3\times 3+4\times 4+5\times 5+6\times 6+7\times 7}{1+2+3+4+5+6+7}$

$= \frac{1+4+9+16+25+36+49}{28}$

$= \frac{140}{28} = 5$

**77.** **(d)** Required number = sum of six numbers − sum of five numbers
= 6 × 20 − 15 × 5 = 120 − 75 = 45

**78.** **(b)** Let, the numbers be $a$, $b$, $c$ and $d$, respectively.
Now, according to the question,

$\frac{a+b+c}{3} = 2d$

$\Rightarrow \quad a+b+c = 6d \qquad \cdots(1)$

Again, from the question,

$\frac{a+b+c+d}{4} = 12$

$\Rightarrow \quad a+b+c+d = 48 \qquad \cdots(2)$

Now, put the value of $a + b + c$ from (1) in (2), we have
$6d + d = 48 \quad \Leftrightarrow 7d = 48$

$\Rightarrow \quad d = \frac{48}{7}$

**79.** **(b)** Let, the numbers be $x$, $x$ + 2, …, $x$ + 10
∴ Required difference = $x$ + 10 − $x$ = 10

**80.** **(b)** On adding 6, arithmetic mean = 24 + 6 = 30
On multiplying by 2.5, arithmetic mean
= 30 × 2.5 = 75

**81.** **(c)** Let, Sachin's new average be $x$ runs.
∴ Total runs in 11 innings = 11($x$ − 5)
Now, according to the questions,

$11(x-5)+120=12x$

$\Rightarrow \quad 12x-11x=65 \quad \Leftrightarrow \quad x=65$ runs

**82.** (d) Sixth result = 6 × 49 + 6 × 52 − 11 × 50 = 294 + 312 − 550 = 56

**83.** (b) Required average weight $=\dfrac{42\times25+28\times40}{42+28}$

$=\dfrac{1025+1120}{70}=\dfrac{2170}{70}=31$ Kg

**84.** (c) Male employees = $x$

Female employees = $y$

Now, according to the question,

$(x+y)\ 12000 = x\times15000 + y\times8000$

$\Rightarrow \quad (x+y)\times12 = 15x+8y$

$\Rightarrow \quad 12x+12y=15x+8y$

$\Rightarrow \quad 3x=4y \quad \Rightarrow \quad \dfrac{x}{y}=\dfrac{4}{3}$

**85.** (a) Third number = average of the five consecutive numbers $=\dfrac{a}{5}$

First number of next sequence $=\dfrac{a}{5}+3$

Now, according to the question,

$\therefore \quad \dfrac{a}{5}+3+\dfrac{a}{5}+4+\dfrac{a}{5}+5+\dfrac{a}{5}+6+\dfrac{a}{5}+7=b$

$\Rightarrow a+25=b$

$\Rightarrow 25=b-a$

$\therefore \quad \dfrac{b-a}{100}=\dfrac{25}{100}=\dfrac{1}{4}$

**86.** **(b)** (P + Q)'s present age = 40 + 20 = 60 years

(P + Q + R)'s present age = 90 years

R's present age = (90 − 60) = 30 years

R's age after 10 years = (30 + 10) = 40 years

**87.** (a) 43 ≤ Average ≤ 44

$\Rightarrow 43\le\dfrac{345+x}{9}\le44$

$\Rightarrow 387\le345+x\le396$

$\Rightarrow 387-345\le x\le396-345$

$\Rightarrow 42\le x\le51$

**88.** (c) Weight of first member = $x$ Kg

Weight of second member = $(x+2)$Kg

Weight of third member = $(x+4)$Kg

Weight of fourth member = $(x+6)$Kg

Weight of fifth member = $(x+8)$Kg

$\therefore$ Difference = $x+8-x=8$ Kg

***Note:***

Note that the difference of weights of two consecutive members is 2 Kg, because average weight is increased by 1 Kg each time.

**89.** (c) Expenditure of 9th person = ₹$x$

Now, according to the question,

$x-\dfrac{x+8\times30}{9}=20$

$\Rightarrow \quad \dfrac{9x-x-240}{9}=20$

$\Rightarrow \quad 8x-240=180$

$\Rightarrow \quad 8x=240+180=420$

$\Rightarrow \quad x=\dfrac{420}{8}=52.5$

Total expenditure = ₹(52.5 + 240) = ₹292.5

**90.** (b) Number of girls = $x$

Number of boys = $600-x$

$\therefore \quad (600-x)\times12+11x$

$=11\dfrac{3}{4}\times600=\dfrac{47}{4}\times600$

$\Rightarrow \quad 7200-12x+11x=7050$

$\Rightarrow \quad x=7200-7050=150$

**91.** (b) Required Average

$=\dfrac{100\times46-61-34+16+43}{90}$

$=\dfrac{4600-36}{90}=\dfrac{4564}{90}=50.7$

**92.** (b) $M+T+W+\text{Th}=4\times420.5=1682$ cm ···(1)

$T+W+\text{Th}+F=4\times440.5=1762$ cm ···(2)

By equation (2)-equation (1), we have

$F-M=1762-1682=80$

Let the rainfall for Monday and Friday be $20x$ and $21x$ cm respectively.

Now, according to the question,

$21x-20x=80$

$\Rightarrow \quad x=80$

$\therefore$ Monday $\Rightarrow$ 80 × 20 = 1600 cm

$\therefore$ Friday $\Rightarrow$ 21 × 80 = 1680 cm

**93.** (a) $m+m+1+m+2+m+3+m+4=5n$

$\Rightarrow \quad 5m+10=5n$

$\Rightarrow \quad m+2=n \quad \Rightarrow \quad m=n-2$ (1)

Required average

$=\dfrac{m+2+m+3+m+4+m+5+m+6+m+7}{6}$

$=\dfrac{6m+27}{6}$

$=\dfrac{2m+9}{2}=\dfrac{2(n-2)+9}{2}=\dfrac{2n+5}{2}$

**94.** **(d)** Let the cricketer's highest score = $x$ runs

$\therefore$ Minimum score = $(x-172)$ runs

$\therefore$ Total runs scored in 40 innings = 40 × 50 = 2000 runs

Total runs scored in 38 innings = 38 × 48 = 1824 runs

Now, according to the question,

$x + x - 172 = 2000 - 1824 = 176$

$\Rightarrow \quad 2x = 176 + 172 = 348$

$\therefore \quad x = \dfrac{348}{2} = 174$

**95.** **(a)** Let the third number be $x$.

$\Rightarrow$ Second number = $2x$ and First number = $4x$

Now, according to the question,

$4x + 2x + x = 154 \times 3$

$\Rightarrow \quad 7x = 462$

$\therefore \quad x = \dfrac{492}{7} = 66$

$\therefore$ First number $= 4x = 4 \times 66 = 264$

**96.** **(d)** Let the number of officers be $x$, then number of the rest officials = $500 - x$

Now, according to the question,

$x \times 14000 + (500 - x)4000 = 5000 \times 500$

$\Rightarrow \quad x \times 14 + (500 - x)4 = 5 \times 500$

$\Rightarrow \quad 14x + 2000 - 4x = 2500$

$\Rightarrow \quad 10x = 2500 - 2000 = 500$

$\Rightarrow \quad x = \dfrac{500}{10} = 50$

**97.** **(d)** Difference = (64 + 62 + 84) − (68 + 65 + 73)

=210 − 206 = 4

$\therefore$ Correct average $= 72 + \dfrac{4}{40} = 72.1$

**98.** **(b)** Let, the first number is $x$.

$\therefore$ Second number = $3x$ and the third number $= \dfrac{3x}{4}$

Now, according to the question,

$x + 3x + \dfrac{3x}{4} = 3 \times 114$

$\Rightarrow \quad \dfrac{4x + 12x + 3x}{4} = 342$

$\Rightarrow \quad 19x = 342 \times 4$

$\therefore \quad x = \dfrac{342 \times 4}{19} = 72$

$\therefore$ Largest number = $3x = 3 \times 72 = 216$

**99.** **(a)** Let, the average of runs was $x$ till 11 innings.

$\therefore$ Total runs = $11x$

$\Rightarrow$ Total run after 12th innings = $11x + 63$

Again, after 12th innings average = $(x + 2)$

$\Rightarrow$ Total run = $12(x + 2)$

Now, according to the question,

$12(x + 2) = 11x + 63$

$\therefore \quad x = 63 - 12 \times 2 = 39$

$\therefore$ The average of his score after 12th innings = 39 + 2 = 41

**100.** **(b)** According to the question,

$\dfrac{A + B}{2} = 20$

$\Rightarrow \quad A + B = 40 \qquad \cdots(1)$

$\dfrac{B + C}{2} = 19$

$\Rightarrow \quad B + C = 38 \qquad \cdots(2)$

$\dfrac{C + A}{2} = 21$

$\Rightarrow \quad C + A = 42 \qquad \cdots(3)$

Adding (1), (2) and (3), we get

$\therefore \quad 2A + 2B + 2C = 120$

$\Rightarrow \quad A + B + C = 60 \qquad \cdots(4)$

$\therefore \quad A = (A + B + C) - (B + C)$

$= 60 - 38 = 22$

**101.** **(e)** Let the partly fixed expenditure be $x$.

And that partly varying be $y$.

Then, $x + 24y = 615 \times 24 \qquad \cdots(1)$

Again, $x + 40y = 465 \times 40 \qquad \cdots(2)$

Solving equations (1) and (2), we get

$x + 24y = 615 \times 24$

$x + 40y = 465 \times 40$

$- \quad - \qquad -$

$16y = 18600 - 14760 = 3840$

$\Rightarrow \quad y = \dfrac{3840}{16} = 240$

Putting the value of $y$ in equation (1), we get $x = 24(615 - 240) = 24 \times 375 = 9000$

Now, when there are 60 students

Average $= \dfrac{9000 + 240 \times 60}{60}$

$= \dfrac{9000 + 14400}{60} = \dfrac{23400}{60} = ₹390$

**102.** **(e)** Total marks = 24 × 56 = 1344

Total of actual marks

= 1344 − (44 + 45 + 61) + (48 + 59 + 67) = 1368

Actual average $= \dfrac{1368}{24} = 57$

**103.** **(d)** Ritu's marks $= 875 \times \dfrac{56}{100} = 490$

Smita's Marks $= 875 \times \dfrac{92}{100} = 805$

Rina's marks = 634

Total marks = 490 + 805 + 634 = 1929

Average $= \dfrac{1929}{3} = 643$

**104.** **(b)** Sum of first two numbers = 30 × 2 = 60

Sum of last two numbers = 70 × 2 = 140

∴ Third number = 260 − 140 − 60 = 60

**105.** **(c)** Since the numbers are consecutive, they should be equidistant from the average, i.e., 42.

Hence the numbers are 39, 41, 43, and 45.

Product of B and D = 41 × 45 = 1845

**106.** **(b)** Ajay's score = 63 + 30 = 93

Rahul's score = 93 − 15 = 78

Manish's + Suresh's score = 63 × 3 − 78 = 189 − 78 = 111

**107.** **(a)** Total ages of 80 boys = 15 × 80 = 1200 years

Total age of 16 boys = 15 × 16 = 240 years

Total age of 25 boys = 14 × 25 = 350 years

Average age of the remaining boys

$$= \frac{1200-(240+350)}{80-(25+15)} = \frac{610}{40} = 15.25 \text{ years.}$$

**109.** **(a)** Ph + Ch + Ma = 120 + Ch

$$\Rightarrow \quad \text{Ph} + \text{Ma} = 120 \Rightarrow \left(\frac{\text{Ph}+\text{Ma}}{2}\right) = 60$$

**110.** **(b)** Required average

$$= \frac{68\times 20 + (72-48) + (61-65)}{20} = 69$$

**111.** **(d)** **From I.** There are 11 students in the class.

**From II.** The average age of students and class teacher is 14 years.

**From III.** The average age of class teacher is 3 years more than that of students.

Now, combining all three statements, we have

Average age of (students + teacher) = 14 × 12 = 168 years

Average age of 11 students = 14 − 3 = 11 years

Total age of 11 students = 11 × 11 = 121 years

∴ Teacher's age = 168 − 121 = 47 years.

# Ratio and Proportion

# 7

## RATIO

A *ratio* is a comparison of two quantities by division. It is a relation that one quantity bears to another with respect to magnitude. In other words, ratio means what part one quantity is of another. The quantities may be of same kind or different kinds. For example, when we consider the ratio of the weight 45 Kg of a bag of rice to the weight 29 Kg of a bag of sugar, we are considering the quantities of same kind but when we talk of allotting 2 cricket bats to 5 sportsmen, we are considering quantities of different kinds. Normally, we consider the ratio between quantities of the same kind.

If $a$ and $b$ are two numbers, the ratio of $a$ to $b$ is $\frac{a}{b}$ or $a \div b$ and is denoted by $a$:$b$. The two quantities that are being compared are called *terms*. The first is called *antecedent* and the second term is called *consequent*.

For example, the ratio 3:5 represents $\frac{3}{5}$ with antecedent 3 and consequent 5.

***Note:***

1. A ratio is a number in order to find the ratio of two quantities and they must be expressed in the same units.
2. A ratio does not change, if both of its terms are multiplied or divided by the same number. Thus,

$$\frac{2}{3} = \frac{4}{6} = \frac{6}{9} \text{ etc.}$$

## TYPES OF RATIOS

1. **Duplicate Ratio:** The ratio of the squares of two numbers is called the *duplicate ratio* of the two numbers.

   For example, $\frac{3^2}{4^2}$ or $\frac{9}{16}$ is called the duplicate ratio of $\frac{3}{4}$.

2. **Triplicate Ratio:** The ratio of the cubes of two numbers is called the *triplicate ratio* of the two numbers.

   For example, $\frac{3^3}{4^3}$ or $\frac{27}{64}$ is triplicate ratio of $\frac{3}{4}$.

3. **Sub-duplicate Ratio:** The ratio of the square roots of two numbers is called the *sub-duplicate ratio* of two numbers.

   For example, $\frac{3}{4}$ is the sub-duplicate ratio of $\frac{9}{16}$.

4. **Sub-triplicate Ratio:** The ratio of the cube roots of two numbers is called the *sub-triplicate ratio* of two numbers.

   For example, $\frac{2}{3}$ is the sub-triplicate ratio of $\frac{8}{27}$.

5. **Inverse Ratio or Reciprocal Ratio:** If the antecedent and consequent of a ratio interchange their places, the new ratio is called the *inverse ratio* of the first.

   Thus, if $a$:$b$ be the given ratio, then $\frac{1}{a}:\frac{1}{b}$ or $b$:$a$ is its inverse ratio.

   For example, $\frac{3}{5}$ is the inverse ratio of $\frac{5}{3}$.

6. **Compound Ratio:** The ratio of the product of the antecedents to that of the consequents of two or more given ratios is called the *compound ratio*. Thus, if $a$:$b$ and $c$:$d$ are two given ratios, then $ac$:$bd$ is the compound ratio of the given ratios.

   For example, if $\frac{3}{4}$, $\frac{4}{5}$ and $\frac{5}{7}$ be the given ratios, then their compound ratio is $\frac{3\times4\times5}{4\times5\times7}$, that is, $\frac{3}{7}$.

## PROPORTION

The equality of two ratios is called *proportion*.

If $\frac{a}{b} = \frac{c}{d}$, then $a$, $b$, $c$ and $d$ are said to be in proportion and we write $a$:$b$::$c$:$d$. This is read as "$a$ is to $b$ as $c$ is to $d$".

For example, since $\frac{3}{4} = \frac{6}{8}$, we write 3:4::6:8 and say 3, 4, 6 and 8 are in proportion.

Each term of the ratio $\frac{a}{b}$ and $\frac{c}{d}$ is called a *proportional.* $a$, $b$, $c$ and $d$ are respectively the first, second, third and fourth proportionals.

Here, $a$, $d$ are known as *extremes* and $b$, $c$ are known as *means*.

## SOME BASIC FORMULAE

1. If four quantities are in proportion, then
   Product of Means = Product of Extremes
   For example, in the proportion $a:b::c:d$, we have, $bc = ad$.

   Product of means

   $a : b : : c : d$

   Product of extremes

   From this relation, we see that if any three of the four quantities are given, then the fourth quantity can be determined.

2. **Fourth proportional:** If $a:b::c:x$, then $x$ is called the *fourth proportional* of $a$, $b$, $c$.

   We have, $\frac{a}{b} = \frac{c}{x}$ or, $x = \frac{b \times c}{a}$.

   Thus, fourth proportional of $a$, $b$, $c$ is $\frac{b \times c}{a}$.

**Illustration 1:** Find a fourth proportional to the numbers 2, 5, 4.

**Solution:** Let $x$ be the fourth proportional, then

$$2:5::4:x \text{ or, } \frac{2}{5} = \frac{4}{x}.$$

$$\therefore \quad x = \frac{5 \times 4}{2} = 10.$$

3. **Third Proportional:** If $a:b::b:x$, then $x$ is called the third proportional of $a$, $b$.

   We have, $\frac{a}{b} = \frac{b}{x}$ or, $x = \frac{b^2}{a}$.

   Thus, third proportional of $a$, $b$ is $\frac{b^2}{a}$.

**Illustration 2:** Find a third proportional to the numbers 2.5, 1.5.

**Solution:** Let $x$ be the third proportional, then

$$2{\cdot}5:1{\cdot}5::1{\cdot}5:x \text{ or } \frac{2\cdot 5}{1\cdot 5} = \frac{1\cdot 5}{x}. \quad \therefore \quad x = \frac{1\cdot 5 \times 1\cdot 5}{2\cdot 5} = 0.9.$$

4. **Mean Proportional:** If $a:x::x:b$, then $x$ is called the *mean* or *second proportional* of $a$, $b$.

   We have, $\frac{a}{x} = \frac{b}{x}$ or, $x^2 = ab$ or, $x = \sqrt{ab}$.

   $\therefore$ Mean proportional of $a$ and $b$ is $\sqrt{ab}$.
   We also say that, $a$, $x$, $b$ are in *continued proportion*.

**Illustration 3:** Find the mean proportional between 48 and 12.

**Solution:** Let $x$ be the mean proportional. Then,

$$48:x::x:12 \text{ or, } \frac{48}{x} = \frac{x}{12} \text{ or, } x^2 = 576 \text{ or, } x = 24.$$

5. If $\frac{a}{b} = \frac{c}{d}$, then

   (i) $\frac{a+b}{b} = \frac{c+d}{d}$ (Componendo)

   (ii) $\frac{a-b}{b} = \frac{c-d}{d}$ (Dividendo)

   (iii) $\frac{a+b}{a-b} = \frac{c+d}{c-d}$ (Componendo and Dividendo)

   (iv) $\frac{a}{b} = \frac{a+c}{b+d} = \frac{a-c}{b-d}$.

**Illustration 4:** The sum of two numbers is $c$ and their quotient is $\frac{p}{q}$. Find the numbers.

**Solution:** Let the numbers be $x$, $y$.

Given: $x + y = c$ $\quad \cdots(1)$

and, $\frac{x}{y} = \frac{p}{q}$ $\quad \cdots(2)$

$$\therefore \quad \frac{x}{x+y} = \frac{p}{p+q} \Rightarrow \frac{x}{c} = \frac{p}{p+q} \quad \text{[Using (1)]}$$

$$\Rightarrow \quad x = \frac{pc}{p+q}.$$

## SOME USEFUL SHORTCUT METHODS

1. (a) If two numbers are in the ratio of $a$:$b$ and the sum of these numbers is $x$, then these numbers will be $\frac{ax}{a+b}$ and $\frac{bx}{a+b}$, respectively.

   or

   If in a mixture of $x$ litres, two liquids A and B are in the ratio of $a$:$b$, then the quantities of liquids A and B in the mixture will be $\frac{ax}{a+b}$ litres and $\frac{bx}{a+b}$ litres, respectively.

   (b) If three numbers are in the ratio of $a$:$b$:$c$ and the sum of these numbers is $x$, then these numbers will be $\frac{ax}{a+b+c}$, $\frac{bx}{a+b+c}$ and $\frac{cx}{a+b+c}$, respectively.

**Explanation**

Let the three numbers in the ratio $a$:$b$:$c$ be $A$, $B$ and $C$. Then,

$$A = ka,\ B = kb,\ C = kc$$

and, $A + B + C = ka + kb + kc = x$

$$\Rightarrow \quad k(a + b + c) = x \Rightarrow k = \frac{x}{a+b+c}.$$

$$\therefore \quad A = ka = \frac{ax}{a+b+c}$$

$$B = kb = \frac{bx}{a+b+c}$$

$$C = kc = \frac{cx}{a+b+c}.$$

**Illustration 5:** Two numbers are in the ratio of 4:5 and the sum of these numbers is 27. Find the two numbers.

**Solution:** Here, $a = 4$, $b = 5$ and $x = 27$.

$\therefore$ The first number $= \frac{ax}{a+b} = \frac{4\times 27}{4+5} = 12$

and, the second number $= \frac{bx}{a+b} = \frac{5\times 27}{4+5} = 15$.

**Illustration 6:** Three numbers are in the ratio of 3:4:8 and the sum of these numbers is 975. Find the three numbers.

**Solution:** Here, $a = 3$, $b = 4$, $c = 8$ and $x = 975$.

$\therefore$ The first number $= \frac{ax}{a+b+c} = \frac{3\times 975}{3+4+8} = 195$.

The second number $= \frac{bx}{a+b+c} = \frac{4\times 975}{3+4+8} = 260$.

and, the third number $= \frac{cx}{a+b+c} = \frac{8\times 975}{3+4+8} = 520$.

2. If two numbers are in the ratio of $a$:$b$ and difference between these numbers is $x$, then these numbers will be

   (a) $\frac{ax}{a-b}$ and $\frac{bx}{a-b}$, respectively (where $a > b$)

   (b) $\frac{ax}{b-a}$ and $\frac{bx}{b-a}$, respectively (where $a < b$).

**Explanation**

Let the two numbers be $ak$ and $bk$.
Let $a > b$. Given: $ak - bk = x$

$$\Rightarrow \quad (a - b)k = x \text{ or, } k = \frac{ax}{a-b}.$$

Therefore, the two numbers are $\frac{ax}{a-b}$ and $\frac{bx}{a-b}$.

**Illustration 7:** Two numbers are in the ratio of 4:5. If the difference between these numbers is 24, then find the numbers.

**Solution:** Here, $a = 4$, $b = 5$ and $x = 24$.

$\therefore$ The first number $= \frac{ax}{b-a} = \frac{4\times 24}{5-4} = 96$

and, the second number $= \frac{bx}{b-a} = \frac{5\times 24}{5-4} = 120$.

3. (a) If $a:b = n_1:d_1$ and $b:c = n_2:d_2$, then
   $a:b:c = (n_1 \times n_2):(d_1 \times n_2):(d_1 \times d_2)$.

   (b) If $a:b = n_1:d_1$, $b:c = n_2:d_2$ and $c:d = n_3:d_3$, then
   $a:b:c:d = (n_1 \times n_2 \times n_3):(d_1 \times n_2 \times n_3):(d_1 \times d_2 \times n_3):(d_1 \times d_2 \times d_3)$.

**Illustration 8:** If $A$:$B$ = 3:4 and $B$:$C$ = 8:9, find $A$:$B$:$C$.

**Solution:** Here, $n_1 = 3$, $n_2 = 8$, $d_1 = 4$ and $d_2 = 9$.

$\therefore \quad A:B:C = (n_1 \times n_2):(d_1 \times n_2):(d_1 \times d_2)$
$= (3 \times 8):(4 \times 8):(4 \times 9)$
$= 24:32:36$ or, 6:8:9.

**Illustration 9:** If $A{:}B = 2{:}3$, $B{:}C = 4{:}5$ and $C{:}D = 6{:}7$, find $A{:}D$.

**Solution:** Here, $n_1 = 2$, $n_2 = 4$, $n_3 = 6$, $d_1 = 3$, $d_2 = 5$ and $d_3 = 7$.

$\therefore$ $A{:}B{:}C{:}D = (n_1 \times n_2 \times n_3){:}(d_1 \times n_2 \times n_3)$
$:(d_1 \times d_2{:}n_3){:}(d_1 \times d_2 \times d_3)$

$= (2 \times 4 \times 6) :(3 \times 4 \times 6){:}(3 \times 5 \times 6) :(3 \times 5 \times 7)$

$= 48{:}72{:}90{:}105$ or, $16{:}24{:}30{:}35$.

Thus, $A{:}D = 16{:}35$.

4. (a) The ratio between two numbers is $a{:}b$. If $x$ is added to each of these numbers, the ratio becomes $c{:}d$. The two numbers are given as:

$$\frac{ax(c-d)}{ad-bc} \text{ and } \frac{bx(c-d)}{ad-bc}.$$

**Explanation**

Let two numbers be $ak$ and $bk$.

Given: $\dfrac{ak+x}{bk+x} = \dfrac{c}{d}$ $\Rightarrow akd + dx = cbk + cx$

$\Rightarrow k(ad - bc) = x(c - d)$

$\Rightarrow k = \dfrac{x(c-d)}{ad-bc}$.

Therefore, the two numbers are $\dfrac{ax(c-d)}{ad-bc}$ and $\dfrac{bx(c-d)}{ad-bc}$.

(b) The ratio between two numbers is $a{:}b$. If $x$ is subtracted from each of these numbers, the ratio becomes $c{:}d$.
The two numbers are given as:

$$\frac{ax(d-c)}{ad-bc} \text{ and } \frac{bx(d-c)}{ad-bc}.$$

**Explanation**

Let the two numbers be $ak$ and $bk$.

Given: $\dfrac{ak-x}{bk-x} = \dfrac{c}{d}$ $\Rightarrow akd - xd = bck - xc$

$\Rightarrow k(ad - bc) = x(d - c)$

$\Rightarrow k = \dfrac{x(d-c)}{ad-bc}$.

Therefore, the two numbers are $\dfrac{ax(d-c)}{ad-bc}$ and $\dfrac{bx(d-c)}{ad-bc}$.

**Illustration 10:** Given two numbers which are in the ratio of 3:4. If 8 is added to each of them, their ratio is changed to 5:6. Find the two numbers.

**Solution:** We have,

$$a{:}b = 3{:}4,\ c{:}d = 5{:}6 \text{ and } x = 8.$$

$\therefore$ The first number $= \dfrac{ax(c-d)}{ad-bc}$

$= \dfrac{3\times 8\times(5-6)}{(3\times 6-4\times 5)} = 12$

and, the second number $= \dfrac{bx(c-d)}{ad-bc}$

$= \dfrac{4\times 8\times(5-6)}{(3\times 6-4\times 5)} = 16$.

**Illustration 11:** The ratio of two numbers is 5:9. If each number is decreased by 5, the ratio becomes 5:11. Find the numbers.

**Solution:** We have,

$$a{:}b = 5{:}9,\ c{:}d = 5{:}11 \text{ and } x = 5.$$

$\therefore$ The first number $= \dfrac{ax(d-c)}{ad-bc}$

$= \dfrac{5\times 5\times(11-5)}{(5\times 11-9\times 5)} = 15$

and, the second number $= \dfrac{bx(d-c)}{ad-bc}$

$= \dfrac{9\times 5\times(11-5)}{(5\times 11-9\times 5)} = 27$.

5. (a) If the ratio of two numbers is $a{:}b$, then the numbers that should be added to each of the numbers in order to make this ratio $c{:}d$ is given by

$$\frac{ad-bc}{c-d}.$$

**Explanation**

Let the required number be $x$.

Given: $\dfrac{a+x}{b+x} = \dfrac{c}{d}$ $\Rightarrow ad + xd = bc + xc$

$\Rightarrow x(d - c) = bc - ad$

or, $x = \dfrac{ad-bc}{c-d}$.

(b) If the ratio of two numbers is $a:b$, then the number that should be subtracted from each of the numbers in order to make this ratio $c:d$ is given by

$$\frac{bc-ad}{c-d}.$$

**Explanation**

Let the required number be $x$.

Given: $\dfrac{a-x}{b-x}=\dfrac{c}{d}$ $\Rightarrow ad - xd = bc - xc$

$\Rightarrow x(c - d) = bc - ad$

or, $x = \dfrac{bc-ad}{c-d}$.

**Illustration 12:** Find the number that must be subtracted from the terms of the ratio 5:6 to make it equal to 2:3.

**Solution:** We have, $a:b$ = 5:6 and $c:d$ = 2:3.

$\therefore$ The required number $= \dfrac{bc-ad}{c-d}$

$= \dfrac{6\times2-5\times3}{2-3} = 3.$

**Illustration 13:** Find the number that must be added to the terms of the ratio 11:29 to make it equal to 11:20.

**Solution:** We have, $a:b$ = 11:29 and $c:d$ = 11:20.

$\therefore$ The required number $= \dfrac{ad-bc}{c-d}$

$= \dfrac{11\times20-29\times11}{11-20} = 11.$

6. There are four numbers $a$, $b$, $c$ and $d$.
   (i) The number that should be subtracted from each of these numbers so that the remaining numbers may be proportional is given by

$$\frac{ad-bc}{(a+d)-(b+c)}.$$

**Explanation**

Let $x$ be subtracted from each of the numbers.

The remainders are $a - x$, $b - x$, $c - x$ and $d - x$.

Given: $\dfrac{a-x}{b-x}=\dfrac{c-x}{d-x}$

$\Rightarrow (a - x)(d - x) = (b - x)(c - x)$

$\Rightarrow ad - x(a + d) + x^2 = bc - x(b + c) + x^2$

$\Rightarrow (b + c)x - (a + d)x = bc - ad$

$\therefore x = \dfrac{bc-ad}{(b+c)-(a+d)}$ or $\dfrac{ad-bc}{(a+d)-(b+c)}$

(ii) The number that should be added to each of these numbers so that the new numbers may be proportional is given by,

$$\frac{bc-ad}{(a+d)-(b+c)}.$$

**Explanation**

Let $x$ be added to each of the numbers.

The new numbers are $a + x$, $b + x$, $c + x$ and $d+x$.

Given: $\dfrac{a+x}{b+x}=\dfrac{c+x}{d+x}$.

$\Rightarrow (a + x)(d + x) = (b + x)(c + x)$

$\Rightarrow ad + x(a + d) + x^2 = bc + x(b + c) + x^2$

$\Rightarrow (a + d)x - (b + c)x = bc - ad.$

$\therefore x = \dfrac{bc-ad}{(a+d)-(b+c)}$.

**Illustration 14:** Find the number subtracted from each of the numbers 54, 71, 75 and 99 leaves the remainders which are proportional.

**Solution:** We have, $a$ = 54, $b$ = 71, $c$ = 75 and $d$ = 99.

The required number $= \dfrac{ad-bc}{(a+d)-(b+c)}$

$= \dfrac{54\times99-71\times75}{(54+99)-(71+75)} = 3.$

7. The incomes of two persons are in the ratio of $a:b$ and their expenditures are in the ratio of $c:d$. If the saving of each person be ₹$S$, then their incomes are given by

$$₹\frac{aS(d-c)}{ad-bc} \text{ and } ₹\frac{bS(d-c)}{ad-bc}.$$

and, their expenditures are given by

$$₹\frac{cS(b-a)}{ad-bc} \text{ and } ₹\frac{dS(b-a)}{ad-bc}.$$

**Explanation**

Let their incomes be ₹$ak$ and ₹$bk$, respectively. Since each person saves ₹$S$,

$\therefore$ Expenditure of first person = ₹$(ak - S)$

and, expenditure of second person = ₹$(bk - S)$.

Given: $\dfrac{ak-S}{bk-S} = \dfrac{c}{d}$

$\Rightarrow$ $akd - Sd = bkc - Sc$

$\Rightarrow$ $k(ad - bc) = (d - c)S$ or, $k = \dfrac{(d-c)S}{ad-bc}$.

Therefore, the incomes of two persons are

$$\frac{a(d-c)S}{ad-bc} \text{ and } \frac{b(d-c)S}{ad-bc}$$

and, their expenditures are

$$ak - S \quad \text{and} \quad bk - S$$

i.e., $\dfrac{a(d-c)S}{ad-bc} - S$ and $\dfrac{b(d-c)S}{ad-bc} - S$

or, $\dfrac{cS(b-a)}{ad-bc}$ and $\dfrac{dS(b-a)}{ad-bc}$.

**Illustration 15:** Annual income of A and B is in the ratio of 5:4 and their annual expenses bear a ratio of 4:3. If each of them saves ₹500 at the end of the year, then find their annual income.

**Solution:** We have, $a:b$ = 5:4, $c:d$ = 4:3 and $S$ = 500.

$\therefore$ Annual income of A $= \dfrac{aS(d-c)}{ad-bc}$

$= \dfrac{5\times 500\times(3-4)}{(5\times 3-4\times 4)}$

= ₹2500.

and annual income of B $= \dfrac{bS(d-c)}{ad-bc}$

$= \dfrac{4\times 500\times(3-4)}{(5\times 3-4\times 4)}$

= ₹2000.

**Illustration 16:** The incomes of Mohan and Sohan are in the ratio 7:2 and their expenditures are in the ratio 4:1. If each saves ₹1000, find their expenditures.

**Solution:** We have, $a:b$ = 7:2, $c:d$ = 4:1 and $S$ = 1000.

$\therefore$ Mohan's expenditure $= \dfrac{cS(b-a)}{ad-bc} = \dfrac{4\times 1000\times(2-7)}{(7\times 1-2\times 4)}$

= ₹20000

and, Sohan's expenditure $= \dfrac{dS(b-a)}{ad-bc} = \dfrac{1\times 1000\times(2-7)}{(7\times 1-2\times 4)}$

= ₹5000.

8. (a) If in a mixture of $x$ litres of two liquids A and B, the ratio of liquids A and B is $a:b$, then the quantity of liquid B to be added in order to make this ratio.

$c:d$ is $\dfrac{x(ad-bc)}{c(a+b)}$.

Quantity of liquid A in the mixture $= \dfrac{ax}{a+b}$.

Quantity of liquid B in the mixture $= \dfrac{bx}{a+b}$.

Let/litres of liquid B to be added in order to make this ratio as $c:d$.

Then, $\dfrac{ax}{a+b} : \dfrac{bx}{a+b} + l = c:d$

or, $\dfrac{ax}{a+b} : \dfrac{bx+l(a+b)}{a+b} = c:d$

or, $\dfrac{ax}{bx+l(a+b)} = \dfrac{c}{d}$ or, $axd = bcx + cl(a+b)$

or, $l = \dfrac{x(ad-bc)}{(a+b)c}$.

(b) In a mixture of two liquids A and B, the ratio of liquids A and B is $a:b$. If on adding $x$ litres of liquid B to the mixture, the ratio of A to B becomes $a:c$, then in the beginning the quantity of liquid A in the mixture was $\dfrac{ax}{c-b}$ litres and that of liquid B was $\dfrac{bx}{c-b}$ litres.

**Explanation**

Let the quantity of mixture be $M$ litres.

Then, the quantity of liquid $A = \dfrac{aM}{a+b}$ litres

and the quantity of liquid $B = \dfrac{bM}{a+b}$ litres.

If $x$ litres of liquid $B$ is added, then

$$\frac{aM}{a+b} : \frac{bM}{a+b} + x = a:c$$

or, $\dfrac{aM}{a+b} : \dfrac{bM+x(a+b)}{a+b} = a{:}c$

or, $\dfrac{aM}{bM+x(a+b)} = \dfrac{a}{c}$ or, $cM = bM + x(a + b)$

or, $M = \dfrac{x(a+b)}{c-b}$.

$\therefore$ Quantity of liquid A $= \dfrac{ax(a+b)}{(c-b)(a+b)}$

$= \dfrac{ax}{c-b}$ litres

and, quantity of liquid B $= \dfrac{bx(a+b)}{(c-b)(a+b)}$

$= \dfrac{bx}{c-b}$ litres.

**Illustration 17:** 729 ml of a mixture contains milk and water in the ratio 7:2. How much more water is to be added to get a new mixture containing milk and water in the ratio of 7:3.

**Solution:** Here, $x = 729$, $a{:}b = 7{:}2$ and $c{:}d = 7{:}3$.

$\therefore$ The quantity of water to be added

$$= \frac{x(ad-bc)}{c(a+b)} = \frac{729\times(7\times3-2\times7)}{7(7+2)} = 81 \text{ ml.}$$

**Illustration 18:** A mixture contains alcohol and water in the ratio of 6:1. On adding 8 litres of water, the ratio of alcohol to water becomes 6:5. Find the quantity of water in the mixture.

**Solution:** We have, $a{:}b = 6{:}1$, $a{:}c = 6{:}5$ and $x=8$.

$\therefore$ The quantity of water in the mixture

$$= \frac{bx}{c-b} = \frac{1\times8}{5-1} = 2 \text{ litres.}$$

9. When two ingredients A and B of quantities $q_1$ and $q_2$ and cost price/unit $c_1$ and $c_2$ are mixed to get a mixture $c$ having cost price/unit $c_m$, then

(a) $\dfrac{q_1}{q_2} = \dfrac{c_2-c_m}{c_m-c_1}$ and

(b) $c_m = \dfrac{c_1\times q_1 + c_2\times q_2}{q_1+q_2}$.

**Illustration 19:** In what ratio the two kinds of tea must be mixed together, one at ₹9 per Kg and another at ₹15 per Kg, so that mixture may cost ₹10.2 per Kg?

**Solution:** We have, $c_1 = 9$, $c_2 = 15$, $c_m = 10.2$

$$\therefore \quad \frac{q_1}{q_2} = \frac{c_2-c_m}{c_m-c_1} = \frac{15-10.2}{10.2-9} = \frac{4.8}{1.2} = \frac{4}{1}.$$

Thus, the two kinds of tea are mixed in the ratio 4:1.

**Illustration 20:** In a mixture of two types of oils $O_1$ and $O_2$, the ratio $O_1{:}O_2$ is 3:2. If the cost of oil $O_1$ is ₹4 per litre and that of $O_2$ is ₹9 per litre, then find the cost per litre of the resulting mixture.

**Solution:** We have, $q_1 = q_2 = 2$, $c_1 = 4$ and $c_2 = 9$.

$\therefore$ The cost of resulting mixture

$$= \frac{c_1\times q_1 + c_2\times q_2}{q_1+q_2} = \frac{4\times3+9\times2}{3+2} = \frac{30}{5}$$

= ₹6.

10.(a) If a mixture contains two ingredients $A$ and $B$ in the ratio $a{:}b$, then percentage of $A$ in the mixture $= \dfrac{a}{a+b} \times 100\%$ and percentage of $B$ in the mixture $= \dfrac{b}{a+b} \times 100\%$

(b) If two mixtures $M_1$ and $M_2$ contain ingredients A and B in the ratios $a{:}b$ and $c{:}d$, respectively, then a third mixture $M_3$ obtained by mixing $M_1$ and $M_2$ in the ratio $x{:}y$ will contain

$$\left[\frac{\dfrac{a\times x}{a+b} + \dfrac{c\times y}{c+d}}{x+y}\right] \times 100\% \text{ ingredient A, and}$$

$$\left[100\% - \left\{\frac{\dfrac{ax}{a+b} + \dfrac{cy}{c+d}}{x+y}\right\}\right]$$

or, $$\left[\frac{\dfrac{bx}{a+b} + \dfrac{dy}{c+d}}{x+y}\right] \times 100\% \text{ ingredient B.}$$

**Illustration 21:** If a mixture contains water and alcohol in the ratio 2:3, then what is the percentage quantity of water in the mixture?

**Solution:** Here, $a = 2$, $b = 3$.

$\therefore$ percentage quantity of water in the mixture

$$= \frac{a}{a+b} \times 100\% = \frac{2}{2+3} \times 100\%$$

$$= \frac{2}{5} \times 100\%$$

$$= \frac{200}{5} \text{ or, } 40\%$$

**Illustration 22:** Two alloys contain silver and copper in the ratio 3:1 and 5:3. In what ratio the two alloys should be added together to get a new alloy having silver and copper in the ratio of 2:1?

**Solution:** We have, $a{:}b = 3{:}1$, $c{:}d = 5{:}3$

Let the two alloys be mixed in the ratio $x{:}y$.

Then, percentage quantity of sliver in the new alloy

$$= \left[\frac{\dfrac{ax}{a+b} + \dfrac{cy}{c+d}}{x+y}\right] \times 100\%$$

$$= \left[\frac{\dfrac{3x}{4} + \dfrac{5y}{8}}{x+y}\right] \times 100\%$$

$$= \frac{6x+5y}{8(x+y)} \times 100\% \qquad \cdots(1)$$

Since, the ratio of silver and copper in the new alloys is 2:1.

$\therefore$ percentage quantity of sliver in the new alloy

$$= \frac{2}{2+1} \times 100\% = \frac{200}{3}\% \qquad \cdots(2)$$

From (1) and (2), we get

$$\frac{6x+5y}{8(x+y)} = \frac{2}{3} \text{ or, } \quad 18x + 15y = 16x + 16y$$

or, $2x = y$ or, $x{:}y = 1{:}2$.

Hence, the two alloys should be mixed in the ratio 1:2.

## Exercise-I

1. Find a fourth proportional to the numbers 60, 48, 30.
   (a) 36 (b) 24
   (c) 48 (d) None of these
2. Find the value of $x$ in the following proportion:
   $27{:}72{::}x{:}8$
   (a) 5 (b) 7
   (c) 3 (d) None of these
3. Find a third proportional to the numbers 4, 42.
   (a) 441 (b) 541
   (c) 641 (d) None of these
4. If $18{:}x = x{:}8$, then $x$ is equal to:
   (a) 12 (b) 16
   (c) 18 (d) None of these
5. The third proportional to 0.8 and 0.2 is:
   (a) 0.6 (b) 0.05
   (c) 0.7 (d) None of these
6. The fourth proportional to 0.2, 0.12 and 0.3 is:
   (a) 0.24 (b) 0.16
   (c) 0.18 (d) None of these
7. In a ratio 11:14, if the antecedent is 55, the consequent is:
   (a) 70 (b) 90
   (c) 60 (d) None of these
8. The mean proportional between 64 and 81 is:
   (a) 48 (b) 68
   (c) 72 (d) None of these
9. The mean proportional of 0.25 and 0.04 is:
   (a) 0.01 (b) 0.1
   (c) $10\sqrt{10}$ (d) None of these
10. The ratio of two numbers is 3:4 and their sum is 420. The greater of the two numbers is:
    (a) 360 (b) 240
    (c) 180 (d) None of these

**11.** The ratio of boys and girls in a school is 9:5. If the total number of students in the school is 1050, then the number of boys is:

(a) 785 (b) 890
(c) 675 (d) None of these

**12.** An amount of ₹1200 is distributed among A, B and C in the ratio of 5:7:13. What is the difference between the shares of C and B?

(a) ₹288 (b) ₹328
(c) ₹296 (d) None of these

**13.** Amit, Sumit and Puneet share an amount of ₹660 in the ratio of 3:4:5. What is the share of Puneet?

(a) ₹375 (b) ₹275
(c) ₹575 (d) None of these

**14.** Three numbers A, B and C are in the ratio of 12:15:25. If sum of these numbers is 312, find the ratio between the difference of B and A and the difference of C and B.

(a) 3:7 (b) 10:3
(c) 3:10 (d) None of these

**15.** The prices of a scooter and a television set are in the ratio of 3:2. If a scooter costs ₹600 more than the television set, then the price of television set is:

(a) ₹1800 (b) ₹1200
(c) ₹2400 (d) None of these

**16.** Two numbers are in the ratio of 4:9. If the larger number is 35 more than the smaller number, then the product of the numbers is:

(a) 1764 (b) 1564
(c) 1864 (d) None of these

**17.** If the income of A, B and C is in the ratio of 2:5:11 and the income of B is ₹291 more than that of A, then the income of C is:

(a) ₹907 (b) ₹1127
(c) ₹1067 (d) None of these

**18.** If $A:B = 7:5$ and $B:C = 9:11$, then $A:B:C$ is equal to:

(a) 55:45:63 (b) 63:45:55
(c) 45:63:55 (d) None of these

**19.** If $A:B = 3/4$, $B:C = 4/5$, $C:D = 5/6$, then $A:D$ will be:

(a) 2:3 (b) 4:3
(c) 1:2 (d) None of these

**20.** If $3A = 4B = 5C$, then $A:B:C$ is:

(a) 16:20:18 (b) 15:20:16
(c) 20:15:12 (d) None of these

**21.** If $3A = 5B$ and $2B = 3C$, then $A:C$ is:

(a) 5:2 (b) 7:2
(c) 3:2 (d) None of these

**22.** Ajay, Aman, Suman and Geeta rented a house and agreed to share the rent as follows:

Ajay:Aman = 8:15, Aman:Suman = 5:8 and Suman:Geeta and Geeta = 4:5. The part of rent paid by Suman will be:

(a) $\frac{24}{77}$ (b) $\frac{12}{55}$
(c) $\frac{13}{66}$ (d) None of these

**23.** The ratio of money with Anju and Sanju is 4:5 and that with Sanju and Manju is 5:6. If Anju has ₹280, then the amount of money Manju has:

(a) ₹320 (b) ₹420
(c) ₹640 (d) None of these

**24.** There are three sections A, B and C in a school of class I. The ratio of students in sections A and B is 3:5 and that in B and C is 4:7. If the total number of students in the class be 201, then the number of students in section A are:

(a) 24 (b) 36
(c) 48 (d) None of these

**25.** The sum of three numbers is 124. If the ratio between the first and second be 2:3 and that between the second and third be 7:9, then the third number is:

(a) 54 (b) 64
(c) 48 (d) None of these

**26.** A, B, C and D share a property worth ₹77500. If A:B = 3:2, B:C = 5:4 and C:D = 3:7, find the share of *B*.

(a) ₹20000 (b) ₹15000
(c) ₹25000 (d) None of these

**27.** Two numbers are in the ratio 3:5. If each number is increased by 10, the ratio becomes 5:7. The numbers are:

(a) 15, 25 (b) 30, 45
(c) 48, 60 (d) None of these

**28.** The ratio between two numbers is 2:3. If each number is increased by 4, the ratio becomes 5:7. The numbers are:

(a) 8, 16 (b) 16, 24
(c) 24, 32 (d) None of these

**29.** Two numbers are in the ratio of 5:6. If 5 is subtracted from each number, the ratio becomes 4:5. The numbers are:

(a) 25, 30 (b) 30, 45
(c) 15, 20 (d) None of these

**30.** The ratio of present ages of Suresh and Mahesh is 7:5. If after 6 years their ages will be in the ratio of 4:3, the present age of Mahesh is:

(a) 32 years (b) 36 years
(c) 30 years (d) None of these

**31.** The ratio of present ages of Sita and Gita is 4:3. If 4 years before, the ratio of their ages was 2:1, the present age of Sita is:

(a) 8 years (b) 10 years
(c) 12 years (d) None of these

**32.** Two numbers are in the ratio of 5:8. If 12 be added to each, they are in the ratio of 3:4. Find the sum of two numbers.

(a) 43 (b) 39
(c) 47 (d) None of these

**33.** Two numbers are in the ratio of 5:7. If 25 be subtracted from each, they are in the ratio of 35:59. Find the difference of the two numbers.

(a) 48 (b) 52
(c) 24 (d) None of these

**34.** When $x$ is added to each term of 7:13, the ratio becomes 2:3. The value of $x$ is:

(a) 7 (b) 11
(c) 5 (d) None of these

**35.** Find the number which, when subtracted from the terms of the ratio 12:17 makes it equal to the ratio 2:3.

(a) 2 (b) 6
(c) 8 (d) None of these

**36.** The value of $k$ that must be added to 7, 16, 43 and 79, so that they are in proportion is:

(a) 7 (b) 5
(c) 9 (d) None of these

**37.** What should be subtracted from 15, 28, 20 and 38, so that the remaining numbers may be proportional?

(a) 2 (b) 4
(c) 6 (d) None of these

**38.** The number that must be added to each of the numbers 8, 21, 13 and 31 to make the ratio of first two numbers equal to the ratio of last two numbers is:

(a) 5 (b) 7
(c) 9 (d) None of these

**39.** The incomes of A and B are in the ratio 3:2 and their expenditures in the ratio 5:3. If each saves ₹1000, A's income is:

(a) ₹5000 (b) ₹6000
(c) ₹8000 (d) None of these

**40.** The annual incomes and expenditures of a man and his wife are in the ratios of 5:3 and 3:1, respectively. If they decide to save equally and find a balance of ₹4000 at the end of year, their incomes were:

(a) ₹5000, ₹3000 (b) ₹6000, ₹4000
(c) ₹3000, ₹2000 (d) None of these

**41.** The incomes of Gupta and Verma are in the ratio 9:4 and their expenditures are in the ratio 7:3. If each saves ₹2000, then Gupta's expenditure is:

(a) ₹6000 (b) ₹8000
(c) ₹7000 (d) None of these

**42.** In a mixture of 60 litres, the ratio of milk and water is 2:1. What amount of water must be added to make the ratio of milk and water as 1:2?

(a) 75 litres (b) 55 litres
(c) 60 litres (d) None of these

**43.** A mixture contains alcohol and water in the ratio of 12:5. On adding 14 litres of water, the ratio of alcohol to water becomes 4:3. The quantity of alcohol in the mixture is:

(a) 18 litres (b) 24 litres
(c) 26 litres (d) None of these

**44.** If an alloy contains copper and silver in the ratio 3:7, then the percentage quantity of silver in the alloy is:

(a) 90% (b) 70%
(c) 60% (d) None of these

**45.** Two alloys contain zinc and copper in the ratio of 2:1 and 4:1. In what ratio the two alloys should be added together to get a new alloy having zinc and copper in the ratio of 3:1?

(a) 7:5 (b) 5:7
(c) 3:5 (d) None of these

**46.** Mixture of milk and water has been kept in two separate containers. Ratio of milk to water in one of the containers is 5:1 and that in the other container is 7:2. In what ratio the mixtures of these two containers should be added together so that the quantity of milk in the new mixture may become 80%?

(a) 2:3 (b) 3:2
(c) 4:5 (d) None of these

## Exercise-2
## (Based on Memory)

1. The ratio of the number of students studying in schools A, B and C is 6:8:7 respectively. If the number of students studying in each of the schools is increased by 20%, 15% and 20% respectively, what will be the new ratio of the number of students in Schools A, B and C?
(a) 18:23:21 (b) 12:18:1
(c) 18:21:17 (d) Cannot be determined
(e) None of these
**[NABARD PO, 2008]**

2. Seven men, five women and eight children were given an assignment of distributing 2000 books to students in a school over a period of three days. All of them distributed books on the first day. One the second day two women and three children remained absent and on the third day three men and five children remained absent. If the ratio of the number of books distributed in a day by a man, a woman and a child was 5:4:2 respectively, a total of approximately how many books were distributed on the second day?
(a) 1000 (b) 800
(c) 650 (d) 900
(e) Cannot be determined
**[SBI PO, 2005]**

3. If $ab = 36$, which of the following proportions is correct?
(a) $9:a = 4:b$ (b) $a:18 = b:3$
(c) $a:6 = b:6$ (d) $a:9 = 4:b$
(e) Cannot be determined
**[Bank of Maharashtra (SO), 2006]**

4. The ratio of the number of students studying in schools A, B and C is 5:6:8. If the number of students studying in each of the schools is increased by 30%, 25% and 25% respectively, what will be the new ratio of the students in schools A, B and C?
(a) 14:15:20 (b) 13:15:20
(c) 13:14:15 (d) 15:17:19
(e) None of these
**[Bank of Maharashtra (S O), 2006]**

5. When 20% of a number is added to another number the number increased by 50%. What is the ratio of the first number to the second?
(a) 3:2 (b) 2:3
(c) 5:2 (d) Cannot be determined
(e) None of these
**[IOB PO, 2006]**

6. In a school the ratio of boys to girls is 4:5. When 100 girls leave the school the ratio becomes 6:7. How many boys are there in the school?
(a) 1600 (b) 1500
(c) 1300 (d) Cannot be determined
(e) None of these
**[IOB PO, 2006]**

7. A sum of ₹817 is divided among A, B and C such that 'A' receives 25% more than 'B' and 'B' receives 25% less than 'C'. What is A's share in the amount:
(a) ₹228 (b) ₹247
(c) ₹285 (d) ₹304
(e) None of these
**[Bank of Baroda PO, 2007]**

8. A sum of money is divided among A, B, C and D in the ratio 3:5:8:9 respectively. If the share of D is ₹1,872 more than the share of A, then what is the total amount of money of B & C together?
(a) ₹4,156 (b) ₹4,165
(c) ₹4,056 (d) ₹4,065
(e) None of these
**[IDBI Bank Officers', 2007]**

9. The ratio of earnings of A and B is 4:5. If the earnings of A increase by 20% and the earnings of B decrease by 20%, the new ratio of their earnings becomes 6:5. What are A's earnings?
(a) ₹22, 000 (b) ₹27, 500
(c) ₹26,400 (d) Cannot be determined
(e) None of these
**[Andhra Bank PO, 2007]**

10. A sum of money is divided among W, X, Y and Z in the ratio of 3:7:9:13. If the share of W and Y together is ₹11, 172, then what is the difference between the amounts of X and Z?
(a) ₹7,672 (b) ₹6,834
(c) ₹5,586 (d) Cannot be determined
(e) None of these
**[Andhra Bank PO, 2007]**

11. The age of Surabhi and Neerja are in the ratio of 6:7. After 6 yea₹the ratio of their ages will be 15:17. What is the age of Neerja?
(a) 24 years (b) 32 years
(c) 26 years (d) 28 years
(e) None of these
**[Andhra Bank PO, 2007]**

**12.** Samiara, Mahira and Kiara rented a set of DVDs at a rent of ₹578. If they used it for 8 hours, 12 hours and 14 hours respectively, what is Kiara's share of rent to be paid:

(a) ₹238 (b) ₹204
(c) ₹192 (d) ₹215
(e) None of these

**[Bank of Maharashtra PO, 2008]**

**13.** 20 boys and 32 girls form a group for social work. During their membership drive same number of boys and girls joined the group. How many members does the group have now, if the ratio of boys to girls is 3:4 respectively?

(a) 33 (b) 60
(c) 75 (d) Cannot be determined
(e) None of these

**[Andhra Bank PO, 2006]**

**14.** Amit, Sumit and Vinit Divide an amount of ₹2,800 amongst themselves in the ratio of 5:6:3 respectively. If an amount of ₹200 is added to each of their shares. What will be the new ratio of their shares of the amount?

(a) 8:9:6 (b) 6:7:4
(c) 7:8:5 (d) 4:5:2
(e) None of these

**[LIC ADO, 2007]**

**15.** If two numbers are respectively 20% and 50% of a third number, then what is the ratio between the two numbers?

(a) 5:2 (b) 2:5
(c) 1:5 (d) 1:2

**[SSC (GL) Prel. Examination, 2008]**

**16.** If A:B = 3:4 , B:C = 5:7 and C:D = 8:9, then the ratio A:D is:

(a) 3:7 (b) 7:3
(c) 21:10 (d) 10:21

**[SSC (GL) Prel. Examination, 2008]**

**17.** If $a$:$b$ = 5:7 and $c$:$d$ = 2$a$:3$b$, then $ac$:$bd$ is:

(a) 20:38 (b) 50:147
(c) 10:21 (d) 50:151

**[SSC (GL) Prel. Examination, 2008]**

**18.** Two numbers are in the ratio 2:3. If 2 is subtracted from the first and 2 is added to the second, then the ratio becomes 1:2. The sum of the numbers is:

(a) 30 (b) 28
(c) 24 (d) 10

**[SSC (GL) Prel. Examination, 2008]**

**19.** ₹68000 are divided among A, B, and C in the ratio $\frac{1}{2}:\frac{1}{4}:\frac{5}{16}$. The difference of the greatest and the smallest parts is:

(a) ₹6000 (b) ₹14440
(c) ₹9200 (d) ₹16000

**[SSC (GL) Prel. Examination, 2008]**

**20.** Three numbers are in the ratios $\frac{1}{2}:\frac{2}{3}:\frac{3}{4}$. The difference between the greatest and the smallest numbers is 36. The numbers are:

(a) 72, 84, 108 (b) 60, 72, 96
(c) 72, 84, 96 (d) 72, 96, 108

**[SSC (GL) Prel. Examination, 2008]**

**21.** The ratio of the incomes of two persons is 5:3 and that of their expenditure is 9:5. If they save ₹2600 and ₹1800 respectively, then their incomes are:

(a) ₹8000, ₹4800 (b) ₹6000, ₹3600
(c) ₹10000, ₹60000 (d) ₹9000, ₹5400

**[SSC (GL) Prel. Examination, 2008]**

**22.** A and B are two different alloys of gold and copper prepared by mixing metals in the proportion 7:2 and 7:11, respectively. If equal quantities of the alloys are melted to form a third alloy C, find the ratio of gold and copper in C.

(a) 5:7 (b) 6:6
(c) 7:5 (d) 14:13

**23.** If $\frac{x}{2y}=\frac{6}{7}$, the value of $\frac{x-y}{x+y}+\frac{14}{19}$ equals

(a) $\frac{13}{19}$ (b) $\frac{15}{19}$

(c) 1 (d) $1\frac{1}{19}$

**[SI of Police Rec. Examination, 1997]**

**24.** The ratio between the annual incomes of A and B is 4:3 and between their annual expenditure is 3 : 2. If at the end of a year both save ₹600 each, find the difference in their incomes.

(a) ₹450 (b) ₹500
(c) ₹600 (d) ₹750

**[SI of Police Rec. Examination, 1997]**

**25.** If $a$, $b$, $c$ and $d$ are real numbers such that $a$:$b$ = $b$:$c$ = $c$:$d$ and $a$:$d$ = 8:125, then the value of $a$:$c$ is:

(a) 25:4 (b) 125:8
(c) 4:25 (d) 8:25

**[SI of Police Rec. Examination, 1997]**

**26.** Three pots have the same volume. The ratio of milk and water in first, second and third pots are 3:2, 7:3 and 11:4, respectively. If the liquid of three pots are mixed, then the ratio of milk and water in the mixture is:

(a) 61:29 (b) 61:30
(c) 5:4 (d) 29:61

**[SI of Police Rec. Examination, 1997]**

**27.** If $\frac{x}{y} = \frac{6}{5}$ the value of $\frac{x^2 + y^2}{x^2 - y^2}$ is:

(a) $\frac{36}{25}$ (b) $\frac{25}{36}$
(c) $\frac{61}{11}$ (d) $\frac{11}{61}$

**[SI of Police Rec. Examination, 1997]**

**28.** If $a:5 = b:7 = c:8$, then $\frac{a+b+c}{a}$:

(a) 4 (b) 2
(c) 7 (d) 1/4

**[SI of Police Rec. Examination, 1997]**

**29.** If $a:b:c = 2:3:4$, then $\frac{1}{a}:\frac{1}{b}:\frac{1}{c}$ is equal to:

(a) 4:3:2 (b) $\frac{1}{2}:\frac{1}{3}:\frac{1}{4}$
(c) $\frac{1}{4}:\frac{1}{3}:\frac{1}{2}$ (d) 3:4:6

**[SI of Police Rec. Examination, 1997]**

**30.** If $x:y = 8:9$, then $5x - 4y:3x + 2y$ is equal to:

(a) 3:2 (b) 2:3
(c) 3:4 (d) 2:21

**[SI of Police Rec. Examination, 1997]**

**31.** Two numbers are in the ratio of 3:4. If 5 is subtracted from each, then the ratio will be 2:3. What is the smaller number?

(a) 15 (b) 18
(c) 20 (d) 24

**[SI of Police Rec. Examination, 1997]**

**32.** Monthly income of Anil and Sunil are in the ratio 5:4 and their expenses are in the ratio 4:3. If each of them saves ₹1200 at the end of the month, their monthly incomes, respectively are:

(a) ₹6000, ₹4800
(b) ₹8000, ₹6400
(c) ₹8000, ₹7200
(d) ₹2000, ₹1600

**[SI of Police Rec. Examination, 1999]**

**33.** A bag contains one rupee, 50 paise and 25 paise coins in the ratio 2:3:5. Their total value is ₹144. The value of 50-paise coins is:

(a) ₹24 (b) ₹36
(c) ₹48 (d) ₹72

**[SI of Police Rec. Examination, 1999]**

**34.** A sum of money is divided among 160 males and some females in the ratio 16:21. Individually each male gets ₹4 and a female ₹3. The number of females is:

(a) 280 (b) 198
(c) 284 (d) 270

**[SI of Police Rec. Examination, 1999]**

**35.** Tea at ₹126 per Kg. and at ₹135 per Kg are mixed with a third variety in the ratio 1:1:2. If the mixture is worth ₹153 per Kg, the price of the third variety (per Kg) is:

(a) ₹169.50 (b) ₹175
(c) ₹175.50 (d) ₹185

**[SI of Police Rec. Examination, 1999]**

**36.** Two numbers are in the ratio 3:4. If 50 is added to each number, the ratio becomes 7:9. The sum of the numbers is:

(a) 50 (b) 350
(c) 700 (d) 800

**[SI of Police Rec. Examination, 1999]**

**37.** If $3A = 5B$ and $4B = 6C$, then $A:C$ is equal to:

(a) 5:2 (b) 3:5
(c) 2:5 (d) 4:5

**[SI of Police Rec. Examination, 1999]**

**38.** A sum of ₹370 is to be divided among A, B and C such that $\frac{\text{A's share}}{\text{B's share}} = \frac{\text{B's share}}{\text{C's share}} = \frac{3}{4}$

Then A's share (in rupees) is:

(a) 240 (b) 120
(c) 100 (d) 90

**[Assistant's Grade Examination, 1997]**

**39.** If the ratio of boys to girls in a class is B and the ratio of girls to boys is G, then 3(B + G) is:

(a) Equal to 3
(b) Less than 3
(c) More than 3
(d) Less than $\frac{1}{3}$

**[Assistant's Grade Examination, 1997]**

**40.** The monthly incomes of two persons are in the ratio 4:7 and their expenses are in the ratio 11:20. If each of them saves ₹400 per month then their monthly income must be respectively:

(a) ₹3600, ₹4200 (b) ₹4000, ₹7000
(c) ₹4200, ₹7350 (d) ₹4800, ₹8400

**[Assistant's Grade Examination, 1997]**

**41.** What number should be subtracted from both the terms of the ratio 15:19 in order to make it 3:4?

(a) 9 (b) 6
(c) 5 (d) 3

**[SSC (GL) Prel. Examination, 2000]**

**42.** If $p:q = r:s:t:u = 2:3$, then:

$(mp + nr + ot):(mq + ns + ou)$ is equal to:

(a) 1:3 (b) 1:2
(c) 2:3 (d) 3:2

**[SSC (GL) Prel. Examination, 2000]**

**43.** If $a:b = c:d = e:f = 1:2$, then

$(pa + qc + re):(pb + qd + rf)$ is equal to:

(a) $p:(q + r)$ (b) $(p + q):r$
(c) 2:3 (d) 1:2

**[SSC (GL) Prel. Examination, 2000]**

**44.** If $x:y = 3:1$, then $x^3 - y^3:x^3 + y^3 = ?$

(a) 13:14 (b) 14:13
(c) 10:11 (d) 11:10

**[SSC (GL) Prel. Examination, 2000]**

**45.** If 10% of $m$ is the same as 20% of $n$. Then $m:n$ is equal to:

(a) 2:1 (b) 1:2
(c) 1:10 (d) 1:20

**[SSC (GL) Prel. Examination, 2000]**

**46.** The ratio $2^{1\cdot5}:2^{0\cdot5}$ is the same as:

(a) 2:1 (b) 3:1
(c) 6:1 (d) 3:2

**[SSC (GL) Prel. Examination, 2000]**

**47.** If $m:n = 3:2$, then $(4m + 5n):(4m - 5n)$ is equal to:

(a) 4:9 (b) 9:4
(c) 11:1 (d) 9:1

**[SSC (GL) Prel. Examination, 2000]**

**48.** The smallest integer, which when subtracted from both the terms of 6:7 gives a ratio less than 16:21, is:

(a) 5 (b) 4
(c) 3 (d) 2

**[SSC (GL) Prel. Examination, 2000]**

**49.** If $\frac{a}{b} = \frac{2}{3}$ and $\frac{b}{c} = \frac{4}{5}$, then the ratio $\frac{a+b}{b+c}$ is equal to:

(a) $\frac{20}{27}$ (b) $\frac{27}{20}$

(c) $\frac{6}{8}$ (d) $\frac{8}{6}$

**50.** The sum of two numbers is 40 and their difference is 4. The ratio of the numbers is:

(a) 21:19 (b) 22:9
(c) 11:9 (d) 11:18

**[SSC (GL) Prel. Examination, 2000]**

**51.** Neeta bought a book at 30% discount on the listed price. Had she not got the discount, she would have paid ₹82.50 extra. At what price did she buy the book?

(a) ₹192.50 (b) ₹275
(c) ₹177.85 (d) Cannot be determined
(e) None of these

**[Canara Bank PO 2003]**

**52.** A man spends ₹1810 for buying bags at ₹200 each and bottles at ₹70 each. What will be the ratio of bags to bottles when maximum number of bags are bought?

(a) 3:8 (b) 8:3
(c) 9:1 (d) 1:9
(e) None of these

**[IBPS Jr. Executive Examination, 2000]**

**53.** If $a:b = 2:3$ and $b:c = 4:5$, find $a^2:b^2:bc$:

(a) 4:9:45 (b) 16:36:45
(c) 16:36:20 (d) 4:36:20

**[SSC (GL) Prel. Examination, 2002]**

**54.** If $A:B = \frac{1}{2}:\frac{3}{8}$, $B:C = \frac{1}{3}:\frac{5}{9}$ and $C:D = \frac{5}{6}:\frac{3}{4}$, then the ratio $A:B:C:D$ is:

(a) 6:4:8:10 (b) 6:8:9:10
(c) 8:6:10:9 (d) 4:6:8:10

**[SSC (GL) Prel. Examination, 2002]**

**55.** Two numbers are in the ratio of 5:7. On diminishing each of them by 40, they become in the ratio 17:27. The difference of the numbers is:

(a) 18 (b) 52
(c) 137 (d) 50

**[SSC (GL) Prel. Examination, 2002]**

**56.** The ratio of the number of boys and girls of a school with 504 students is 13:11. What will be the new ratio if 12 more girls are admitted?

(a) 91:81 (b) 81:91
(c) 9:10 (d) 10:9

**[SSC (GL) Prel. Examination, 2002]**

**57.** A and B have monthly incomes in the ratio 5:6 and monthly expenditures in the ratio 3:4. If they save ₹1800 and ₹1600 respectively, find the monthly income of B.

(a) ₹3400 (b) ₹2700
(c) ₹1720 (d) ₹7200

**[SSC (GL) Prel. Examination, 2002]**

**58.** A sum of ₹9000 is to be distributed among A, B and C in the ratio 4:5:6. What will be the difference between A's and C's shares?

(a) ₹600 (b) ₹1000
(c) ₹900 (d) ₹1200

**[SSC (GL) Prel. Examination, 2002]**

**59.** Zinc and copper are in the ratio of 5:3 in 200 gm of an alloy. How many grams of copper should be added to make the ratio 3:5?

(a) $133\frac{1}{3}$ (b) $\frac{1}{200}$
(c) 72 (d) 66

**[SSC (GL) Prel. Examination, 2002]**

**60.** Divide ₹7500 among A, B and C such that A's share to B's share is in the ratio 5:2 and B's share to C's share is in the ratio 7:13. How much will B receive?

(a) ₹1400 (b) ₹3500
(c) ₹2600 (d) ₹7000

**[SSC (GL) Prel. Examination, 2002]**

**61.** The ratio of copper and zinc in brass is 13:7. How much zinc will be there in 100 kg of brass?

(a) 20 Kg (b) 55 Kg
(c) 35 Kg (d) 40 Kg

**[SSC (GL) Prel. Examination, 2002]**

**62.** If $A$:$B$:$C$ = 2:3:4, then $\frac{A}{B}:\frac{B}{C}:\frac{C}{A}$ is equal to:

(a) 8:9:16 (b) 8:9:12
(c) 8:9:24 (d) 4:9:16

**[SSC (GL) Prel. Examination, 2002]**

**63.** If $A$:$B$ = 1:2, $B$:$C$ = 3:4 and $C$:$D$ = 5:6, find $D$:$C$:$B$:$A$:

(a) 6:5:4:2 (b) 6:3:2:1
(c) 6:4:2:1 (d) 48:40:30:15

**[SSC (GL) Prel. Examination, 2002]**

**64.** Two numbers are in the ratio $1\frac{1}{2}:2\frac{2}{3}$. When each of these is increased by 15, they become in the ratio $1\frac{2}{3}:2\frac{1}{2}$. The greater of the numbers is:

(a) 27 (b) 36

(c) 48 (d) 64

**[SSC (GL) Prel. Examination, 2002]**

**65.** The students in three classes are in the ratio 2:3:5. If 40 students are increased in each class, the ratio changes to 4:5:7. Originally, the total number of students was:

(a) 100 (b) 180
(c) 200 (d) 400

**[SSC (GL) Prel. Examination, 2002]**

**66.** The ratio of incomes of two persons is 5:3 and that of their expenditures is 9:5. Find the income of each person, if they save ₹1,300 and ₹900, respectively.

(a) ₹4000, ₹2400 (b) ₹3000, ₹1800
(c) ₹5000 ₹300 (d) ₹450 ₹2700

**[SSC (GL) Prel. Examination, 2002]**

**67.** If the ratio of the areas of two squares is 1:4, then the ratio of their perimeters is:

(a) 1:2 (b) 1:4
(c) 1:6 (d) 1:8

**[SSC (GL) Prel. Examination, 2002]**

**68.** An equilational triangle is described on the diagonal of a square. What is the ratio of the area of the triangle to that of the square?

(a) $\sqrt{3:2}$ (b) $2:\sqrt{3}$
(c) $\sqrt{3}:4$ (d) $4:\sqrt{3}$

**[SSC (GL) Prel. Examination, 2002]**

**69.** If $x$:$y$ = 3:4, then $(7x + 3y):(7x - 3y)$ is equal to:

(a) 5:2 (b) 4:3
(c) 11:3 (d) 37:19

**[SSC (GL) Prel. Examination, 2002]**

**70.** If $a$:$b$ = 5:7 and $c$:$d$ = 2$a$:3$b$, then $ac$:$bd$ is:

(a) 20:38 (b) 50:147
(c) 10:21 (d) 50:151

**[SSC (GL) Prel. Examination, 2002]**

**71.** If $A$:$B$ = 2:3, $B$:$C$ = 4:5, and $C$:$D$ = 6:7, then $A$:$B$:$C$:$D$ is:

(a) 18:24:30:35 (b) 16:24:30:35
(c) 16:22:30:35 (d) 16:24:15:35

**[SSC (GL) Prel. Examination, 2002]**

**72.** The three numbers are in the ratio $\frac{1}{2}:\frac{2}{3}:\frac{3}{4}$. The difference between the greatest and the smallest numbers is 36. Find the numbers.

(a) 72, 84, 108 (b) 60, 72, 96
(c) 72, 84, 96 (d) 72, 96, 108

**[SSC (GL) Prel. Examination, 2002]**

**73.** The ratio of the number of girls and boys participating in sports of a school is 4:5. If the number of girls is 212, then determine the number of boys participating in the sports:

(a) 256 (b) 265
(c) 251 (d) 263

**[SSC (GL) Prel. Examination, 2002]**

**74.** The ratio of market price of wheat and paddy is 2 : 3 and the ratio of the quantities consumed in a family is 5:4. Find the ratio of the expenditures of wheat and paddy:

(a) 6:5 (b) 5:6
(c) 1:1 (d) 8:15

**[SSC (GL) Pre. Examination, 2002]**

**75.** If $a:b = \frac{2}{9}:\frac{1}{3}$, $b:c = \frac{2}{7}:\frac{5}{14}$ and $d:c = \frac{7}{10}:\frac{3}{5}$, then $a:b:c:d$ is:

(a) 4:6:7:9 (b) 16:24:30:35
(c) 8:12:15:7 (d) 30:35:24:16

**[SSC (GL) Prel. Examination, 2003]**

**76.** The incomes of A, B and C are in the ratio 7:9:12 and their spendings are in the ratio 8:9:15. If $A$ saves $\frac{1}{4}$ of his income, then the savings of A, B and C are in the ratio of:

(a) 56:99:69 (b) 69:56:99
(c) 99:56:69 (d) 99:69:56

**[SSC (GL) Prel. Examination, 2003]**

**77.** In an alloy, the ratio of copper and zinc is 5:2. If 1.250 Kg of zinc is mixed in 17 Kg 500 gm of alloy, then the ratio of copper and zinc will be:

(a) 2:1 (b) 2:3
(c) 3:2 (d) 1:2

**[SSC (GL) Prel. Examination, 2003]**

**78.** If 378 coins consist of rupee, 50 paise and 25 paise coins whose values are in the ratio of 13:11:7, the number of 50-paise coins will be:

(a) 132 (b) 128
(c) 136 (d) 133

**[SSC (GL) Prel. Examination, 2003]**

**79.** If $A:B = 2:3$ and $B:C = 4:5$, then $A:B:C$ is:

(a) 2:12:5 (b) 8:12:15
(c) 12:8:15 (d) 15:12:8

**[SSC (GL) Prel. Examination, 2000]**

**80.** If $A:B = \frac{1}{2}:\frac{1}{3}$, $B:C = \frac{1}{2}:\frac{1}{3}$, then $A:B:C$ is equal to:

(a) 2:3:3 (b) 1:2:6
(c) 3:2:6 (d) 9:6:4

**[SSC (GL) Prel. Examination, 2000]**

**81.** Instead of dividing ₹117 among P, Q, R in the ratio $\frac{1}{2}:\frac{1}{3}:\frac{1}{4}$, it was divided in the ratio 2:3:4 by mistake. Who gained in this transaction?

(a) Only P (b) Only Q
(c) Only R (d) Both Q and R

**[SSC (GL) Prel. Examination, 2000]**

**82.** A boy contains 10-paise coins and 25-paise coins in the ratio 17:6. If the total money in the bag is ₹112, then the number of 10-paise coins is:

(a) 35 (b) 210
(c) 490 (d) 595

**[SSC (GL) Prel. Examination, 2000]**

**83.** If 2A = 3B and 4B = 5C, Then A:C is:

(a) 4:3 (b) 8:15
(c) 15:8 (d) 3:4

**[OBC PO Examination, 2000]**

**84.** If $(x:y) = 2:1$ then $(x^2 - y^2):(x^2 + y^2)$ is:

(a) 3:5 (b) 5:3
(c) 1:3 (d) 3:1
(e) None of these

**[RRB, 2009]**

**85.** The intensity of illumination on a surface from a source of light varies inversely as the square of the distance of the surface from the source. The effect of moving a piece of paper 3 times as far from the source is to:

(a) Divide the intensity by 3
(b) Multiply the intensity by 3
(c) Divide the intensity by 9
(d) Multiply the intensity by 9

**86.** A jar contains black and white marbles. If there are ten marbles in the jar, then which of the following could not be the ratio of black to white marbles?

(a) 9:1 (b) 7:3
(c) 1:10 (d) 1:4

**87.** Eight people are planning to share equally the cost of a rental car. If one person withdraws from the arrangement and the others share equally the entire cost of the car, then the share of each of the remaining persons increased by:

(a) One-ninth (b) One-eighth
(c) One-seventh (d) Seven-eighth

**88.** Determine the ratio of the number of people having characteristic *X* to the number of people having characteristic *Y* in a population of 100 subjects from the following table:

| | |
|---|---|
| Having *X* and *Y* | 10 |
| Having *X* but not *Y* | 30 |
| Having *Y* but not *X* | 20 |
| Having neither *X* nor *Y* | 40 |

(a) 4:3 (b) 3:2
(c) 1:2 (d) 2:3

**89.** When a number is added to another number the total becomes $3\frac{1}{3}$ per cent of the second number. What is the ratio between the first and the second number?

(a) 3:7 (b) 7:4
(c) 7:3 (d) Data inadequate

**[BSRB Mumbai PO, 1998]**

**90.** An amount of money is to be distributed among P, Q and R in the ratio 6:19:7, respectively. If R gives ₹200 of his share to Q, the ratio among P, Q and R becomes 3:10:3, respectively. What was the total amount?

(a) ₹6400 (b) ₹12800
(c) ₹3200 (d) Data inadequate

**[Bank of Baroda PO, 1999]**

**91.** A man in his will distributed his money in such a way that half of it is for his wife, two-third of the remaining equally to three of his sons and the remaining amount equally to four of his daughters. If each of the daughters receives ₹20000, how much money will each of his sons receive?

(a) ₹50333.33 (b) ₹48233.33
(c) ₹53333.33 (d) Data inadequate

**[SBI Associates PO, 1999]**

**92.** The ratio between the present ages of P and Q is 5:8. After 4 years, the ratio between their ages will be 2:3. What is Q's age at present?

(a) 36 years (b) 20 years
(c) 24 years (d) None of these

**[Guwahati PO, 1999]**

**93.** The ratio of P's and Q's ages is 5:7. If the difference between the present age of Q and the age of P six years hence is 2, then what is the total of present ages of P and Q?

(a) 52 years (b) 48 years
(c) 56 years (d) Data inadequate

**[Guwahati PO, 1999]**

**94.** An amount of money is to be distributed among P, Q and R in the ratio 5:8:12, respectively. If the total share of Q and R is four times that of P, what is definitely P's share?

(a) ₹3000 (b) ₹5000
(c) ₹8000 (d) Data inadequate

**[BSRB Mumbai PO, 1999]**

**95.** In a business, A and C invested amounts in the ratio 2:1, whereas the ratio between amounts invested by A and B was 3:2. If ₹1,57,300 was their profit, how much amount did B receive?

(a) ₹72600 (b) ₹48400
(c) ₹36300 (d) ₹24200

**[BSRB Calcutta PO, 1999]**

**96.** An amount of money is to be divided among P, Q and R in the ratio 4:9:16. If R gets 4 times more that P, what is Q's share in it?

(a) ₹1800 (b) ₹2700
(c) ₹3600 (d) Data inadequate

**[BSRB Hyderabad PO, 1999]**

**97.** When 30 per cent of a number is added to another number, the second number increases by its 20 per cent. What is the ratio between the first and the second number?

(a) 3:2 (b) 2:3
(c) 2:5 (d) Data inadequate

**[NABARD, 1999]**

**98.** The ratio of A's and B's salary is 9:4. If A's salary is increased by 15%, then his total salary becomes ₹5175. What is the salary of B?

(a) ₹2000 (b) ₹4000
(c) ₹4500 (d) ₹2500

**[BSRB Chennai PO, 2000]**

**99.** Mohan is younger than Sohan by 10 years. If 5 years back their ages were in the ratio 1:2, how old is Sohan?

(a) 20 (b) 15
(c) 25 (d) Data inadequate

**[BSRB Chennai PO, 2000]**

**100.** Ratio of present ages of P and Q is 7:3. After four years their ages are in the ratio 2:1. What is the present age of P?

(a) 24 years (b) 28 years
(c) 32 years (d) Data inadequate

**[BSRB Chennai PO, 2000]**

**101.** An amount of ₹125000 is to be distributed among Raju, Monu and Sonu in the respective ratio of 2:3:5. What will be the difference between Monu and Raju's share?

(a) ₹25000 (b) ₹12500
(c) ₹18750 (d) ₹2500

**[BSRB Bangalore PO, 2000]**

**102.** The ratio of present ages of Ram and Shyam is 7:8, respectively. Four years after, hence this ratio becomes 9:10, respectively. What is Ram's present age in years?

(a) 18 (b) 14
(c) 17 (d) Data inadequate

**[BSRB Bangalore PO, 2000]**

**103.** Salaries of A, B and C were in the ratio 3:5:7, respectively. If their salaries were increased by 50 per cent, 60 per cent and 50 per cent, respectively, what will be the new ratio of their respective salaries?

(a) 3:6:7 (b) 4:5:7
(c) 4:5:8 (d) None of these

**[BSRB Delhi PO, 2000]**

**104.** The incomes of A, B and C are in the ratio 7:9:12 and their spending are in the ratio 8:9:15. If A saves one-fourth of his income, then the savings of A, B and C are in the ratio of:

(a) 69:56:48 (b) 47:74:99
(c) 37:72:49 (d) 56:99:69

**[SSC (GL), 2011]**

**105.** The third proportional of 38 and 15 is:

(a) $\frac{38 \times 38}{15}$ (b) $\frac{15}{38 \times 38}$

(c) $\frac{15 \times 15}{38}$ (d) $\frac{38 \times 15}{2}$

**[BSRB Patna PO, 2001]**

**106.** An amount of money is to be divided among P, Q and R in the ratio of 3:5:7, respectively. If the amount received by R is ₹4,000 more than the amount received by Q, what will be the total amount received by P and Q together?

(a) ₹8,000 (b) ₹12,000
(c) ₹16,000 (d) Cannot be determined

**[Gramin Bank U.P. (SO) Examination, 2012]**

**107.** The ratio of students in school A, B and C is 5:4:7 respectively. If number of students in schools are increased by 20 per cent, 25 per cent and 20 per cent respectively then what will be the ratio of students in school A, B and C, respectively?

(a) 5:5:7 (b) 30:25:42
(c) 30:20:49 (d) Cannot be determined

**[Syndicate Bank PO, 2010]**

**108.** On Republic Day, sweets were to be equally distributed among 450 children. But on that particular day, 150 children remained absent. Thus, each child got 3 sweets extra. How many sweets did each child get?

(a) 6 (b) 12
(c) 9 (d) Cannot be determined

**[Bank of India PO, 2010]**

**109.** If $\frac{x}{2y} = \frac{6}{7}$, the value of $\frac{x-y}{x+y} + \frac{14}{19}$ equals

(a) $\frac{13}{19}$ (b) $\frac{15}{19}$

(c) 1 (d) $1\frac{1}{19}$

**[SI of Police Rec. Examination, 1997]**

**110.** The ratio between the annual incomes of A and B is 4:3 and between their annual expenditure is 3:2. If at the end of a year both save ₹600 each, find the difference in their incomes.

(a) ₹450 (b) ₹500
(c) ₹600 (d) ₹750

**[SI of Police Rec. Examination, 1997]**

**111.** If $a$, $b$, $c$ and $d$ are real numbers such that $a{:}b = b{:}c = c{:}d$ and $a{:}d = 8{:}125$, then the value of $a{:}c$ is:

(a) 25:4 (b) 125:8
(c) 4:25 (d) 8:25

**[SI of Police Rec. Examination, 1997]**

**112.** Three pots have the same volume. The ratio of milk and water in first, second and third pots are 3:2, 7:3 and 11:4, respectively. If the liquid of three pots are mixed, then the ratio of milk and water in the mixture is:

(a) 61:29 (b) 61:30
(c) 5:4 (d) 29:61

**[SI of Police Rec. Examination, 1997]**

**113.** An AC consumes 8 units of electricity in 30 minutes and a bulb consumes 18 units of electricity in 6 hours. How much total unit of electricity will both AC and bulb consume in 8 days if they run 10 hours a day?

(a) 1280 units (b) 1528 units
(c) 1520 units (c) 1520 units

**[Corporation Bank PO, 2009]**

**114.** Monthly income of Anil and Sunil are in the ratio 5:4 and their expenses are in the ratio 4:3. If each of them saves ₹1200 at the end of the month, their monthly incomes, respectively are:

(a) ₹6000, ₹4800
(b) ₹8000, ₹6400
(c) ₹8000, ₹7200
(d) ₹2000, ₹1600

**[SI of Police Rec. Examination, 1999]**

**115.** The respective ratio between the speeds of a car, a jeep and a tractor is 3:5:2. The speed of the jeep is 250 per cent the speed of the tractor which covers 360 Km in 12 hours. What is the average speed of car and jeep together?

(a) 60 Km/h (b) 75 Km/h
(c) 40 Km/h (d) Cannot be determined

**[CBI (PO), 2010]**

**116.** A sum of money is divided among 160 males and some females in the ratio 16:21. Individually, each male gets ₹4 and a female ₹3. The number of females is:

(a) 280 (b) 198
(c) 284 (d) 270

**[SI of Police Rec. Examination, 1999]**

**117.** Tea at ₹126 per Kg. and at ₹135 per Kg are mixed with a third variety in the ratio 1:1:2. If the mixture is worth ₹153 per Kg, the price of the third variety (per Kg) is:

(a) ₹169.50 (b) ₹175
(c) ₹175.50 (d) ₹185

**[SI of Police Rec. Examination, 1999]**

**118.** Mr. Pandit owned 950 gold coins all of which he distributed amongst his three daughters Lalita, Amita and Neela. Lalita gave 25 gold coins to her husband, Amita donated 15 gold coins and Neeta made jewellery out of 30 gold coins. The new respective ratio of the coins left with them was 20:73:83. How many gold coins did Amita receive from Mr. Pandit?

(a) 380 (b) 415
(c) 400 (d) 350

**[Punjab National Bank PO, 2010]**

**119.** When 30 per cent of one number is subtracted from another number, the second number reduces to its four-fifth. What is the ratio between the first and the second number respectively?

(a) 4:7 (b) 3:2
(c) 2:5 (d) Cannot be determined

**[Allahabad Bank PO, 2010]**

**120.** A sum of ₹370 is to be divided among A, B and C such that $\frac{\text{A's share}}{\text{B's share}} = \frac{\text{B's share}}{\text{C's share}} = \frac{3}{4}$

Then A's share (in rupees) is:

(a) 240 (b) 120
(c) 100 (d) 90

**[Assistant's Grade Examination, 1997]**

**121.** If $p:q = r:s::t:u = 2:3$, then

$(mp + nr + ot):(mq + ns + ou)$ is equal to:

(a) 1:3 (b) 1:2
(c) 2:3 (d) 3:2

**[SSC (GL) Prel. Examination, 2000]**

**122.** Neeta bought a book at 30 per cent discount on the listed price. Had she not got the discount, she would have paid ₹82.50 extra. At what price did she buy the book?

(a) ₹192.50
(b) ₹275
(c) ₹177.85
(d) Cannot be determined

**[Canara Bank PO, 2003]**

**123.** A man spends ₹1810 for buying bags at ₹200 each and bottles at ₹70 each. What will be the ratio of bags to bottles, when maximum number of bags are bought?

(a) 3:8 (b) 8:3
(c) 9:1 (d) 1:9

**[IBPS Jr. Executive Examination, 2000]**

**124.** If $a:b = 2:3$ and $b:c = 4:5$, find $a^2:b^2:bc$:

(a) 4:9:45 (b) 16:36:45
(c) 16:36:20 (d) 4:36:20

**[SSC (GL) Prel. Examination, 2002]**

**125.** Zinc and copper are in the ratio of 5:3 in 200 gm of an alloy. How many grams of copper should be added to make the ratio 3:5?

(a) $133\frac{1}{3}$ (b) $\frac{1}{200}$
(c) 72 (d) 66

**[SSC (GL) Prel. Examination, 2002]**

**126.** Divide ₹7500 among A, B and C such that A's share to B's share is in the ratio 5:2 and B's share to C's share is in the ratio 7:13. How much will B receive?

(a) ₹1400 (b) ₹3500
(c) ₹2600 (d) ₹7000

**[SSC (GL) Prel. Examination, 2002]**

**127.** Two numbers are in the ratio $1\frac{1}{2}:2\frac{2}{3}$. When each of these is increased by 15, they become in the ratio $1\frac{2}{3}:2\frac{1}{2}$. The greater of the numbers is:

(a) 27 (b) 36
(c) 48 (d) 64

**[SSC (GL) Prel. Examination, 2002]**

**128.** The students in three classes are in the ratio 2:3:5. If 40 students are increased in each class, the ratio changes to 4:5:7. Originally, the total number of students was:

(a) 100 (b) 180
(c) 200 (d) 400

**[SSC (GL) Prel. Examination, 2002]**

**129.** An equilateral triangle is described on the diagonal of a square. What is the ratio of the area of the triangle to that of the square?

(a) $\sqrt{3}:2$ (b) $2:\sqrt{3}$
(c) $\sqrt{3}:4$ (d) $4:\sqrt{3}$

**[SSC (GL) Prel. Examination, 2002]**

**130.** The three numbers are in the ratio $\frac{1}{2}:\frac{2}{3}:\frac{3}{4}$. The difference between the greatest and the smallest numbers is 36. Find the numbers.

(a) 72, 84, 108 (b) 60, 72, 96
(c) 72, 84, 96 (d) 72, 96, 108

**[SSC (GL) Prel. Examination, 2002]**

**131.** If $a:b = \frac{2}{9}:\frac{1}{3}$, $b:c = \frac{2}{7}:\frac{5}{14}$ and $d:c = \frac{7}{10}:\frac{3}{5}$, then $a:b:c:d$ is:

(a) 4:6:7:9 (b) 16:24:30:35
(c) 8:12:15:7 (d) 30:35:24:16

**[SSC (GL) Prel. Examination, 2003]**

**132.** The incomes of A, B and C are in the ratio 7:9:12 and their spendings are in the ratio 8:9:15. If A saves one-fourth of his income, then the savings of A, B and C are in the ratio of:

(a) 56:99:69 (b) 69:56:99
(c) 99:56:69 (d) 99:69:56

**[SSC (GL) Prel. Examination, 2003]**

**133.** In an alloy, the ratio of copper and zinc is 5:2. If 1.250 Kg of zinc is mixed in 17.500 Kg of alloy, then the ratio of copper and zinc will be:

(a) 2:1 (b) 2:3
(c) 3:2 (d) 1:2

**[SSC (GL) Prel. Examination, 2003]**

**134.** Instead of dividing ₹117 among P, Q, R in the ratio $\frac{1}{2}:\frac{1}{3}:\frac{1}{4}$, it was divided in the ratio 2:3:4 by mistake. Who gained in this transaction?

(a) Only P (b) Only Q
(c) Only R (d) Both Q and R

**[SSC (GL) Prel. Examination, 2000]**

**135.** A man divides his property so that his son's share to his wife's and wife's share to his daughter's are both in the ratio 3:1. If the daughter gets ₹10,000 less than son, the value (in rupees) of the whole property is:

(a) ₹16,250 (b) ₹16,000
(c) ₹18,250 (d) ₹17,000

**[SSC, 2014]**

**136.** In a class there are $z$ students. Out of them $x$ are boys. What part of the class is composed of girls?

(a) $\frac{x}{z}$ (b) $\frac{z}{x}$
(c) $1-\frac{x}{z}$ (d) $\frac{x}{z}-1$

**[SSC, 2013]**

**137.** The third proportional of 12 and 18 is:

(a) 3 (b) 6
(c) 27 (d) 144

**[SSC, 2013]**

**138.** Ram got twice as many marks in English as in Science. His total marks in English, Science and Mathematics are 180. If the ratio of his marks in English and Mathematics is 2:3, what are his marks in Science?

(a) 30 (b) 60
(c) 72 (d) 90

**[SSC, 2013]**

**139.** Three numbers are in the ratio 2:3:4. If the sum of their squares is 1856, then the numbers are:

(a) 8, 12 and 16 (b) 16, 24 and 32
(c) 12, 18 and 24 (d) None of the above

**[SSC, 2013]**

**140.** If $x$ runs are scored by $A$, $y$ runs by $B$ and $z$ runs by $C$, then $x:y = y:z = 3:2$. If total number of runs scored by $A$, $B$ and $C$ is 342, the runs scored by each would be respectively:

(a) 144, 96, 64 (b) 162, 108, 72
(c) 180, 120, 80 (d) 189, 126, 84

**[SSC, 2013]**

**141.** ₹900 is divided among A, B, C; the division is such that $\frac{1}{2}$nd of A's money $=\frac{1}{3}$rd of B's money $=\frac{1}{4}$th of C's money. Find the amount received by A, B and C.

(a) 300, 400, 200
(b) 350, 450, 100
(c) 200, 300, 400
(d) 400, 150, 350

**[SSC, 2013]**

**142.** If ₹126.50 is divided among A, B and C in the ratio of 2:5:4, the share of B exceeds that of A by:

(a) ₹36.50 (b) ₹35.50
(c) ₹34.50 (d) ₹33.50

**[SSC, 2013]**

**143.** A box contains ₹56 in the form of coins of one-rupee, 50-paise and 25-paise. The number of 50-paise coins is double the number of 25-paise coins and four times the number of one-rupee coins. How many 50-paise coins are there in the box?

(a) 52 (b) 64
(c) 32 (d) 16

**[SSC Assistant Grade III, 2013]**

**144.** The students in three classes are in the ratio 4:6:9. If 12 students are increased in each class, the ratio changes to 7:9:12. Then the total number of students in the three classes before the increase is:

(a) 95 (b) 76
(c) 100 (d) 114

**[SSC, 2012]**

**145.** There is a ratio of 5:4 between two numbers. If 40 per cent of the first is 12, then 50% of the second number is:

(a) 12 (b) 24
(c) 18 (d) 20

**[SSC, 2012]**

**146.** Annual income of Amit and Veer are in the ratio 3:2, while the ratio of their expenditures is 5:3. If at the end of the year each saves ₹1,000, the annual income of Amit is:

(a) ₹9,000 (b) ₹8,000
(c) ₹7,000 (d) ₹6,000

**[SSC, 2012]**

**147.** $P$ varies inversely with the product of $Q$ and $R$. When $Q = 6$ and $R = 12$, $P = 75$. When $Q = 5$, $R = 10$, then $P$ is:

(a) 75 (b) 6
(c) 108 (d) 12

**[SSC, 2012]**

**148.** ₹846 is divided among A, B and C such that 8 times A's share is equal to 12 times B's share and also equal to 6 times C's share. How much did B get?

(a) ₹399 (b) ₹192
(c) ₹288 (d) ₹72

**[SSC, 2012]**

**149.** The population of town is 3,11,250. The ratio between women and men is 43:40. If there are 24% literate among men and 8% literate among women, the total number of literate persons in the town is:

(a) 41,800 (b) 48,900
(c) 56,800 (d) 99,600

**[SSC, 2012]**

**150.** A and B earn in the ratio 2:1. They spend in the ratio 5:3 and save in the ratio 4:1. If the total monthly savings of both A and B are ₹5,000, the monthly income of B is:

(a) ₹7,000 (b) ₹14,000
(c) ₹5,000 (d) ₹10,000

**[SSC, 2011]**

**151.** The ratio of the sum of two numbers and their difference is 5:1. The ratio of the greater number to the smaller number is:

(a) 2:3 (b) 3:2
(c) 5:1 (d) 1:5

**[SSC, 2011]**

**152.** An employer reduces the number of his employees in the ratio 9:8 and increases their wages in the ratio 14:15. If the original wage bill was ₹18,900, find the ratio in which the wage bill is decreased.

(a) 20:21 (b) 21:20
(c) 20:19 (d) 19:21

**[SSC, 2011]**

**153.** ₹1050 are divided among A, B and C in such a way that the share of A is $\frac{2}{5}$ of the combinedshare of B and C. A will get:

(a) ₹200 (b) ₹300
(c) ₹320 (d) ₹420

**[SSC, 2010]**

**154.** If A:B = 2:3, B:C = 4:5 and C:D = 5:9, then A:D is equal to:

(a) 11:17 (b) 8:27
(c) 5:9 (d) 2:9

**[SSC, 2010]**

**Directions (Q. 155–167):** Read the following information carefully to answer the following questions.

In a college, 150 students of MBA are enrolled. The ratio of boys to girls is 7:8. There are three disciplines in the college, namely, Marketing, HR and Finance. In the Marketing discipline, there are 50% girls of their total number and the boys are 40% of their total number. In the HR discipline, girls are 30% of their total number while boys are 30% of their total number. The Finance discipline has girls 20% of their total number and the boys are 30% of their total number. 7 boys and 9 girls are in the HR and Marketing both. 6 boys and 7 girls are in the HR and Finance both. 5 boys and 8 girls are in the Marketing and Finance both. 2 boys and 3 girls are enrolled in all the three disciplines.

**155.** What percentage of students are enrolled in all three disciplines?

(a) 3.33% (b) 7.2%
(c) 8.5% (d) 9.32%
(e) None of these

**[IBPS PO/MT, 2013]**

**156.** What is the ratio of boys to girls only in the Marketing discipline?

(a) 13:9 (b) 9:13
(c) 9:11 (d) 11:9
(e) None of these

**[IBPS PO/MT, 2013]**

**157.** The ratio of the number of boys in the Marketing and Finance disciplines both to that of girls only in the Finance discipline is:

(a) 5:3 (b) 3:5
(c) 5:4 (d) 4:7
(e) None of these

**[IBPS PO/MT, 2013]**

**158.** By what percent is the number of boys in the Marketing discipline more than the number of girls in the HR discipline?

(a) $13\frac{1}{3}\%$ (b) $33\frac{1}{3}\%$

(c) $14\frac{2}{3}\%$ (d) $16\frac{2}{3}\%$

(e) None of these

**[IBPS PO/MT, 2013]**

**159.** The ratio of boys to girls enrolled only in the HR discipline is:

(a) 10:11 (b) 9:10
(c) 7:5 (d) 5:7
(e) None of these

**[IBPS PO/MT, 2013]**

**160.** When X is subtracted from the numbers 9, 15 and 27, the remainders are in continued proportion. What is the value of X?

(a) 8 (b) 6
(c) 4 (d) 5
(e) None of these

**[IBPS PO/MT, 2012]**

**161.** A certain amount was to be distributed among A, B and C in the ratio 2:3:4, but was erroneously distributed in the ratio 7:2:5. As a result of this, B received ₹40 less. What is the actual amount?

(a) ₹210 (b) ₹270
(c) ₹230 (d) ₹280
(e) None of these

**[IBPS PO/MT, 2012]**

**162.** ₹73,689 are divided between A and B in the ratio 4:7. What is the difference between thrice the share of A and twice the share of B?

(a) ₹36,699 (b) ₹46,893
(c) ₹20,097 (d) ₹26,796
(e) ₹13,398

**[IBPS PO/MT, 2012]**

**163.** What is the amount invested in Scheme 'B'?

**Statements:**

**I.** The amounts invested in Schemes 'A' and 'B' are in the ratio of 2:3.
**II.** The amount invested in Scheme 'A' is 40% of the total amount invested.
**III.** The amount invested in Scheme 'A' is ₹45,000.

(a) Only I and II (b) Only I and III
(c) Only II and III (d) All I, II and III
(e) Only III and either I or II.

**[SBI Associates Banks PO, 2011]**

**164.** 20 boys and 32 girls form a group for social work. During their membership drive, an equal number of boys and girls also joined the group. How many members does the group have now, if the ratio of boys to girls is 3:4?

(a) 75 (b) 86
(c) 68 (d) 82
(e) None of these

**[Andhra Bank PO, 2011]**

**165.** 53% of a number is 358 less than the square of 26. What is the value of 3/4 of 23% of that number?

(a) 101 (b) 109.5
(c) 113 (d) 103.5
(e) None of these

**[Corporation Bank PO, 2011]**

**166.** The ratio of the present ages of Anju and Sandhya is 13:17. Four years ago the ratio of their ages was 11:15. What will be the ratio of their ages six years later?

(a) 3:4 (b) 7:8
(c) 5:4 (d) 6:5
(e) None of these

**[Corporation Bank PO, 2010]**

**167.** When 30% of one number is subtracted from another number, the second number reduces to its 4/5. What is the ratio of the first to the second number?

(a) 4:7
(b) 3:2
(c) 2:5
(d) Cannot be determined
(e) None of these

**[Allahabad Bank PO, 2010]**

**Directions (Q. 168–172):** Study the information carefully to answer the following questions.

On the occasion of an opening ceremony of a sports event, in a stadium, there are 600 players who are participating in four different events, that is, Athletics, Table Tennis, Kho-Kho and Lawn Tennis. The ratio of male to female players is 11:4. 30% of the female players are participating in Athletics. 10% of the female players are participating in Table Tennis. The remaining female players are participating in Kho-Kho and Lawn Tennis in the ratio of 1:3. The ratio of male players who are participating in Athletics and other events together is 3:5. 4% of those male players who are not participating in Athletics are participating in Lawn Tennis. Remaining male players are participating in Table Tennis and Kho-Kho in the ratio 5:3.

**168.** What is the ratio of the male players participating in Lawn Tennis to the female players participating in Table Tennis?

(a) 11:72 (b) 11:38
(c) 11:16 (d) 16:13
(e) None of these

**[Indian Bank PO, 2010]**

**169.** What is the total number of players (both males and females together) participating in Table Tennis and Athletics together?

(a) 360 (b) 358
(c) 374 (d) 396
(e) None of these

**[Indian Bank PO, 2010]**

**170.** What is the ratio of the female players participating in Lawn Tennis to those participating in Table Tennis?

(a) 9:5 (b) 4:7
(c) 7:4 (d) 9:2
(e) None of these

**[Indian Bank PO, 2010]**

**171.** What is the difference between the male players participating in Kho-Kho and the female players participating in Lawn Tennis?

(a) 27 (b) 31
(c) 83 (d) 76
(e) None of these

**[Indian Bank PO, 2010]**

**172.** What is the total number of female players who are participating in Athletics and Kho-Kho together?

(a) 68 (b) 72
(c) 58 (e) 67
(e) None of these

**[Indian Bank PO, 2010]**

## ANSWER KEYS

### EXERCISE-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (c) | **3.** (a) | **4.** (a) | **5.** (b) | **6.** (c) | **7.** (a) | **8.** (c) | **9.** (b) | **10.** (b) | **11.** (c) | **12.** (a) | **13.** (b) |
| **14.** (c) | **15.** (b) | **16.** (a) | **17.** (c) | **18.** (b) | **19.** (c) | **20.** (c) | **21.** (a) | **22.** (a) | **23.** (b) | **24.** (b) | **25.** (a) | **26.** (b) |
| **27.** (a) | **28.** (b) | **29.** (a) | **30.** (c) | **31.** (a) | **32.** (b) | **33.** (c) | **34.** (c) | **35.** (a) | **36.** (b) | **37.** (a) | **38.** (a) | **39.** (b) |
| **40.** (a) | **41.** (d) | **42.** (c) | **43.** (b) | **44.** (b) | **45.** (c) | **46.** (a) | | | | | | |

### EXERCISE-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (c) | **3.** (d) | **4.** (b) | **5.** (c) | **6.** (e) | **7.** (c) | **8.** (c) | **9.** (d) | **10.** (c) | **11.** (d) | **12.** (a) | **13.** (e) |
| **14.** (b) | **15.** (b) | **16.** (d) | **17.** (b) | **18.** (a) | **19.** (d) | **20.** (d) | **21.** (a) | **22.** (c) | **23.** (c) | **24.** (c) | **25.** (c) | **26.** (a) |
| **27.** (c) | **28.** (a) | **29.** (b) | **30.** (d) | **31.** (a) | **32.** (a) | **33.** (b) | **34.** (a) | **35.** (c) | **36.** (c) | **37.** (a) | **38.** (d) | **39.** (c) |
| **40.** (d) | **41.** (d) | **42.** (c) | **43.** (d) | **44.** (a) | **45.** (a) | **46.** (a) | **47.** (c) | **48.** (c) | **49.** (a) | **50.** (c) | **51.** (a) | **52.** (b) |
| **53.** (b) | **54.** (c) | **55.** (d) | **56.** (a) | **57.** (d) | **58.** (d) | **59.** (a) | **60.** (a) | **61.** (c) | **62.** (c) | **63.** (d) | **64.** (c) | **65.** (c) |
| **66.** (a) | **67.** (a) | **68.** (a) | **69.** (c) | **70.** (b) | **71.** (b) | **72.** (d) | **73.** (b) | **74.** (b) | **75.** (b) | **76.** (a) | **77.** (a) | **78.** (a) |
| **79.** (b) | **80.** (d) | **81.** (c) | **82.** (d) | **83.** (c) | **84.** (a) | **85.** (c) | **86.** (c) | **87.** (c) | **88.** (a) | **89.** (c) | **90.** (a) | **91.** (c) |
| **92.** (d) | **93.** (b) | **94.** (d) | **95.** (b) | **96.** (d) | **97.** (b) | **98.** (a) | **99.** (c) | **100.** (b) | **101.** (b) | **102.** (b) | **103.** (d) | **104.** (d) |
| **105.** (c) | **106.** (c) | **107.** (b) | **108.** (c) | **109.** (c) | **110.** (c) | **111.** (c) | **112.** (a) | **113.** (c) | **114.** (a) | **115.** (a) | **116.** (a) | **117.** (c) |
| **118.** (a) | **119.** (d) | **120.** (d) | **121.** (c) | **122.** (a) | **123.** (b) | **124.** (b) | **125.** (a) | **126.** (a) | **127.** (c) | **128.** (c) | **129.** (a) | **130.** (d) |
| **131.** (b) | **132.** (a) | **133.** (a) | **134.** (c) | **135.** (a) | **136.** (c) | **137.** (c) | **138.** (a) | **139.** (b) | **140.** (b) | **141.** (c) | **142.** (c) | **143.** (b) |
| **144.** (b) | **145.** (a) | **146.** (d) | **147.** (c) | **148.** (b) | **149.** (b) | **150.** (a) | **151.** (b) | **152.** (b) | **153.** (b) | **154.** (b) | **155.** (a) | **156.** (b) |
| **157.** (c) | **158.** (d) | **159.** (a) | **160.** (e) | **161.** (a) | **162.** (e) | **163.** (e) | **164.** (e) | **165.** (d) | **166.** (e) | **167.** (e) | **168.** (c) | **169.** (e) |
| **170.** (d) | **171.** (a) | **172.** (b) | | | | | | | | | | |

## EXPLANATORY ANSWERS

### EXERCISE-1

**1.** **(b)** Let $x$ be the fourth proportional, then

$60:48:30:x$ or, $\dfrac{60}{48} = \dfrac{30}{x}$

$\therefore\ x = \dfrac{30 \times 38}{60} = 24.$

**2.** **(c)** We have, $27:72::x:8$ or, $\dfrac{27}{72} = \dfrac{x}{8}$

$\therefore\ x = \dfrac{8 \times 27}{72} = 3.$

**3.** **(a)** Let $x$ be the third proportional, then

$4:42::42:x$ or, $\dfrac{4}{42} = \dfrac{42}{x}$.

$\therefore\ x = \dfrac{42 \times 42}{4} = 441.$

**4.** **(a)** We have, $\dfrac{18}{x} = \dfrac{x}{8}$ or, $x^2 = 18 \times 8$

or, $x = \sqrt{144} = 12.$

**5.** **(b)** Let $x$ be the third proportional. Then,

$0.8:0.2::0.2:x$ or, $\dfrac{0.8}{0.2} = \dfrac{0.2}{x}$

$\therefore\ x = \dfrac{0.2 \times 0.2}{0.8} = 0{\cdot}05.$

**6.** **(c)** Let $x$ be the fourth proportional. Then,

$0.2:0.2::0.2\ x$ or, $\dfrac{0.2}{0.12} = \dfrac{0.3}{x}$.

$\therefore\ x = \dfrac{0.3 \times 0.12}{0.2} = 0.18$

**7. (a)** $\frac{11}{14} = \frac{11\times5}{14\times5} = \frac{55}{70}$.

$\therefore$ Consequent = 70.

**8. (c)** Let $x$ be the mean proportional. Then,

$64{:}x{::}\,x{:}81$ or, $\frac{64}{x} = \frac{x}{81}$ or, $x^2 = 5184$ or, $x = 72$.

**9. (b)** Let $x$ be the mean proportional. Then,

$0.25{:}x{:}x{:}0.04$ or, $\frac{0.25}{x} = \frac{x}{0.04}$

or, $x^2 = 0.01$ or, $x = 0.1$

**10. (b)** Here, $a = 3$, $b = 4$ and $x = 420$.

$\therefore$ The first number $= \frac{ax}{a+b} = \frac{3\times420}{3+4} = 180$.

and, the second number $= \frac{bx}{a+b} = \frac{4\times420}{3+4} = 240$.

**11. (c)** Here, $a = 9$, $b = 5$ and $x = 1050$.

$\therefore$ Number of boys $= \frac{ax}{a+b} = \frac{9\times1050}{9+5} = 675$.

**12. (a)** We have, $a = 5$, $b = 7$, $c = 13$ and $x = 1200$.

$\therefore$ Share of B $= \frac{bx}{a+b+c} = \frac{7\times1200}{5+7+13} = 336$

and, share of C $= \frac{cx}{a+b+c} = \frac{13\times1200}{5+7+13} = 624$.

The difference between the shares of C and B = 624 − 336 = 288

**13. (b)** Here, $a = 3$, $b = 4$, $c = 5$ and $x = 660$.

$\therefore$ Share of Puneet $= \frac{cx}{a+b+c} = \frac{5\times660}{3+4+5} =$ ₹275.

**14. (c)** We have, $a = 12$, $b = 15$, $c = 25$ and $x = 312$.

$\therefore$ A $= \frac{ax}{a+b+c} = \frac{12\times312}{12+15+25} = 72$,

B $= \frac{bx}{a+b+c} = \frac{15\times312}{12+15+25} = 90$

and, C $= \frac{cx}{a+b+c} = \frac{25\times312}{12+15+25} = 150$.

$\therefore$ B − A = 18 and C − B = 60

Thus, their ratio = 18:60 or, 3:10.

**15. (b)** Here, $a = 3$, $b = 2$ and $x = 600$.

$\therefore$ The price of a television set $= \frac{bx}{a-b} = \frac{2\times600}{3-2}$

= ₹1200.

**16. (a)** Here, $a = 4$, $b = 9$ and $x = 35$.

$\therefore$ The first number $= \frac{ax}{b-a} = \frac{4\times35}{9-4} = 28$

and, the second number $= \frac{bx}{b-a} = \frac{9\times35}{9-4} = 63$.

Thus, the product of the numbers = 28 × 63 = 1764.

**17. (c)** Ratio of the income of A, B and C = 2:5:11.

$\therefore$ Ratio of the income of A and B = 2:5.

Difference between income of A and B = ₹291.

$\therefore$ Income of C $= \frac{cx}{b-a} = \frac{11\times291}{5-2} =$ ₹1067.

[Here, $a = 2$, $b = 5$, $c = 11$ and $x = 291$]

**18. (b)** Here, $n_1 = 7$, $n_2 = 9$, $d_1 = 5$ and $d_2 = 11$.

$\therefore$ $A{:}B{:}C = (n_1 \times n_2){:}(d_1 \times n_2){:}(d_1 \times d_2)$

$= (7 \times 9){:}(5 \times 9){:}(5 \times 11)$

$= 63{:}45{:}55$.

**19. (c)** We have, $n_1 = 3$, $n_2 = 4$, $n_3 = 5$,

$d_1 = 4$, $d_2 = 5$ and $d_3 = 6$.

$\therefore$ $A{:}B{:}C{:}D = (n_1 \times n_2 \times n_3){:}(d_1 \times n_2 \times n_3)$
$(d_1 \times d_2 \times n_3){:}(d_1 \times d_2 \times d_3)$

$= (3 \times 4 \times 5){:}(4 \times 4 \times 5){:}(4 \times 5 \times 5){:}(4 \times 5 \times 6)$

$= 60{:}80{:}100{:}120$ or, $3{:}4{:}5{:}6$.

Thus, $A{:}D = 3{:}6$ or, $1{:}2$.

**20. (c)** We have, $A{:}B = 4{:}3$ and $B{:}C = 5{:}4$.

Here, $n_1 = 4$, $n_2 = 5$, $d_1 = 3$ and $d_2 = 4$.

$\therefore$ $A{:}B{:}C = (n_1 \times n_2){:}(d_1 \times n_2){:}(d_1 \times d_2)$

$= (4 \times 5){:}(3 \times 5){:}(3 \times 4)$

$= 20{:}15{:}12$.

**21. (a)** We have, $A{:}B = 5{:}3$ and $B{:}C = 3{:}2$.

Here, $n_1 = 5$, $n_2 = 3$, $d_1 = 3$ and $d_2 = 2$.

$\therefore$ $A{:}B{:}C = (n_1 \times n_2){:}(d_1 \times n_2){:}(d_1 \times d_2)$

$= (5 \times 3){:}(3 \times 3){:}(3 \times 2)$

$= 15{:}9{:}6$ or $5{:}3{:}2$.

Thus, $A{:}C = 5{:}2$.

**22. (a)** We have, $A{:}B = 8{:}15$, $B{:}C = 5{:}8$ and $C{:}D = 4{:}5$.

Here, $n_1 = 8$, $n_2 = 5$, $n_3 = 4$, $d_1 = 15$, $d_2 = 8$ and $d_3 = 5$.

$\therefore$ $A{:}B{:}C{:}D = (n_1 \times n_2 \times n_3){:}(d_1 \times n_2 \times n_3){:}(d_1 \times d_2 \times n_3)$
${:}(d_1 \times d_2 \times d_3)$

$= (8 \times 5 \times 4){:}(15 \times 5 \times 4){:}(15 \times 8 \times 4)$
${:}(15 \times 8 \times 5)$

$= 160{:}300{:}480{:}600$ or, $8{:}15{:}24{:}30$.

Thus, Suman pays $= \frac{24}{8+15+2430}$ of the rent

$= \frac{24}{77}$ of the rent.

**23. (b)** We have, $A{:}B = 4{:}5$ and $B{:}C = 5{:}6$.

Here, $n_1 = 4$, $n_2 = 5$, $d_1 = 5$ and $d_2 = 6$.

$\therefore$ $A{:}B{:}C = (n_1 \times n_2){:}(d_1 \times n_2){:}(d_1 \times d_2)$

$= (4 \times 5){:}(5 \times 5){:}(5 \times 6)$

$= 20{:}25{:}30$ or, $4{:}5{:}6$.

Thus, ratio of money with Anju, Sanju and Manju is 4:5:6.

Since, Anju has ₹280, the amount of money Manju has $= \frac{280}{4} \times 6 =$ ₹420.

**24.** **(b)** We have, $A:B = 3:5$ and $B:C = 4:7$.

Here, $n_1 = 3$, $n_2 = 4$, $d_1 = 5$ and $d_2 = 7$.

$\therefore$ $A:B:C = (n_1 \times n_2):(d_1 \times n_2):(d_1 \times d_2)$
$= (3 \times 4):(5 \times 4):(5 \times 7)$
$= 12:20:35.$

The total number of students = 201.

$\therefore$ The number of students in section $A$

$$= \frac{12}{12+20+35} \times 201 = 36.$$

**25.** **(a)** We have, $A:B = 2:3$ and $B:C = 7:9$.

Here, $n_1 = 2$, $n_2 = 7$, $d_1 = 3$ and $d_2 = 9$.

$\therefore$ $A:B:C = (n_1 \times n_2):(d_1 \times n_2):(d_1 \times d_2)$
$= (2 \times 7):(3 \times 7):(3 \times 9)$
$= 14:21:27.$

Since, the sum of the numbers is 124, the third number is $\frac{27}{14+21+27} \times 124 = 54$.

**26.** **(b)** We have, $A:B = 3:2$, $B:C = 5:4$ and $C:D = 3:7$.

Here, $n_1 = 3$, $n_2 = 5$, $n_3 = 3$, $d_1 = 2$, $d_2 = 4$ and $d_3 = 7$.

$\therefore$ $A:B:C:D = (n_1 \times n_2 \times n_3):(d_1 \times n_2 \times n_3) :(d_1 \times d_2 \times n_3):(d_1 \times d_2 \times d_3)$
$= (3 \times 5 \times 3):(2 \times 5 \times 3):(2 \times 4 \times 3):(2 \times 4 \times 7)$
$= 45:30:24:56$

$\therefore$ B's share of property worth ₹77500 is

$$= \left(\frac{30}{45+30+24+56}\right) \times 77500 = ₹15000.$$

**27.** **(a)** We have, $a:b = 3:5$, $c:d = 5:7$ and $x = 10$.

$\therefore$ The first number $= \frac{ax(c-d)}{ad-bc} = \frac{3\times10\times(5-7)}{(3\times7-5\times5)} = 15$

and, the second number $= \frac{bx(c-d)}{ad-bc}$

$$= \frac{5\times10\times(5-7)}{(3\times7-5\times5)} = 25.$$

**28.** **(b)** We have, $a:b = 2:3$, $c:d = 5:7$ and $x = 4$.

$\therefore$ The first number $= \frac{ax(c-d)}{ad-bc}$

$$= \frac{2\times4\times(5-7)}{(2\times7-3\times5)} = 16.$$

and, the second number $= \frac{bx(c-d)}{ad-bc}$

$$= \frac{3\times4\times(5-7)}{(2\times7-3\times5)} = 24.$$

**29.** **(a)** We have, $a:b = 5:6$, $c:d = 4:5$ and, $x = 5$.

$\therefore$ The first number $= \frac{ax(d-c)}{ad-bc}$

$$= \frac{5\times5\times(5-4)}{(5\times5-6\times4)} = 25$$

and, the second number $= \frac{bx(d-c)}{ad-bc}$

$$= \frac{6\times5\times(5-4)}{(5\times5-6\times4)} = 30.$$

**30.** **(c)** We have, $a:b = 7:5$, $c:d = 4:3$ and $x = 6$.

$\therefore$ The present age of Mahesh $= \frac{bx(c-d)}{ad-bc}$

$$= \frac{5\times6\times(4-3)}{(7\times3-5\times4)}$$

= 30 years.

**31.** **(a)** We have, $a:b = 4:3$, $c:d = 2:1$ and $x = 4$.

$\therefore$ The present age of Sita $= \frac{ax(d-c)}{ad-bc}$

$$= \frac{4\times4\times(1-2)}{(4\times1-3\times2)}$$

= 8 years.

**32.** **(b)** We have, $a:b = 5:8$, $c:d = 3:4$ and $x = 12$.

$\therefore$ The first number $= \frac{ax(c-d)}{ad-bc}$

$$= \frac{5\times12\times(3-4)}{(5\times4-8\times3)} = 15$$

and, the second number $= \frac{bx(c-d)}{ad-bc}$

$$= \frac{8\times12\times(3-4)}{(5\times4-8\times3)} = 24.$$

The sum of two numbers = 24 + 15 = 39

**33.** **(c)** We have, $a:b = 5:7$, $c:d = 35:59$ and $x = 25$.

$\therefore$ The first number $= \frac{ax(d-c)}{ad-bc}$

$$= \frac{5\times25\times(59-35)}{(5\times59-7\times35)} = 60$$

and, the second number $= \frac{bx(d-c)}{ad-bc}$

$$= \frac{7\times25\times(59-35)}{(5\times59-7\times35)} = 84$$

$\therefore$ The difference of two numbers = 84 − 60 = 24.

**34.** **(c)** We have, $a:b = 7:13$ and $c:d = 2:3$.

$$\therefore \quad x = \frac{ad-bc}{c-d} = \frac{7\times3-13\times2}{2-3} = 5.$$

**35.** **(a)** We have, $a:b = 12:17$ and $c:d = 2:3$.

$\therefore$ The required number $= \frac{bc-ad}{c-d}$

$$= \frac{17\times2-12\times3}{2-3} = 2.$$

**36.** **(b)** Here, $a = 7$, $b = 16$, $c = 43$ and $d = 79$.

$\therefore \quad k = \dfrac{bc - ad}{(a+d)-(b+c)} = \dfrac{16\times 43 - 7\times 79}{(7+79)-(16+43)} = 5.$

**37.** **(a)** Here, $a = 15$, $b = 28$, $c = 20$ and $d = 38$.

$\therefore$ The required number $= \dfrac{ad - bc}{(a+d)-(b+c)}$

$= \dfrac{15\times 38 - 28\times 20}{(15+38)-(28+20)}$

$= 2.$

**38.** **(a)** Here, $a = 8$, $b = 21$, $c = 13$ and $d = 31$.

$\therefore$ The required number $= \dfrac{bc - ad}{(a+d)-(b+c)}$

$= \dfrac{21\times 13 - 8\times 31}{(8+31)-(21+13)}$

$= 5.$

**39.** **(b)** We have, $a:b = 3:2$, $c:d = 5:3$ and $S = 1000$.

$\therefore$ $A$'s income $= \dfrac{aS(d-c)}{ad-bc}$

$= \dfrac{3\times 1000\times(3-5)}{(3\times 3 - 2\times 5)}$

$=$ ₹6000.

**40.** **(a)** We have, $a:b = 5:3$, $c:d = 3:1$ and $S = 2000$.

$\therefore$ Income of man $= \dfrac{aS(d-c)}{ad-bc}$

$= \dfrac{5\times 2000\times(1-3)}{(5\times 1 - 3\times 3)}$

$=$ ₹5000

and, the income of his wife

$= \dfrac{bS(d-c)}{ad-bc} = \dfrac{3\times 2000\times(1-3)}{(5\times 1 - 3\times 3)}$

$=$ ₹3000.

**41.** **(d)** We have, $a:b = 9:4$, $c:d = 7:3$ and $S = 2000$.

$\therefore$ Gupta's expenditure $= \dfrac{cS(b-a)}{ad-bc}$

$= \dfrac{7\times 2000\times(4-9)}{(9\times 3 - 4\times 7)} =$ ₹70000.

**42.** **(c)** Here, $x = 60$, $a:b = 2:1$ and $c:d = 1:2$.

$\therefore$ Required amount of water to be added

$= \dfrac{x(ad-bc)}{c(a+b)} = \dfrac{60\times(2\times 2 - 1\times 1)}{1(2+1)} = 60$ litres.

**43.** **(b)** The two given ratios are 12:5 and 4:3.

In order to equate the antecedents of the two ratios, we write the second ratio as 12:9.

Now, we have, $a:b = 12:5$, $c:d = 12:9$ and $x = 14$

$\therefore$ The quantity of alcohol in the mixture

$= \dfrac{ax}{c-b} = \dfrac{12\times 14}{12-5} = 24$ litres.

**44.** **(b)** Here, $a = 3$ and $b = 7$.

$\therefore$ percentage quantity of silver in the alloy

$= \left(\dfrac{b}{a+b}\right) \times 100\% = \left(\dfrac{7}{3+7}\right) \times 100\% = 70\%$

**45.** **(c)** We have, $a:b = 2:1$, $c:d = 4:1$.

Let the two alloys be mixed in the ratio $x:y$.

Then, percentage quantity of zinc in the new alloy

$= \left[\dfrac{\dfrac{ax}{a+b} + \dfrac{cy}{c+d}}{x+y}\right] \times 100\%$

$= \left[\dfrac{\dfrac{2x}{3} + \dfrac{4y}{5}}{x+y}\right] \times 100\%$

$= \dfrac{10x+12y}{15(x+y)} \times 100\% \qquad \cdots(1)$

Since, the ratio of zinc and copper in the new alloy is 3:1

$\therefore$ percentage quantity of zinc in the new alloy

$= \dfrac{3}{3+1}\times 100\% = \dfrac{300}{4}\%$ or, 57% $\qquad \cdots(2)$

From (1) and (2), we get

$\dfrac{10x+12y}{15(x+y)} = \dfrac{3}{4}$ or, $40x + 48y = 45(x+y)$

or, $5x = 3y$ or, $x:y = 3:5$.

Hence, the alloys should be mixed in the ratio 3:5.

**46.** **(a)** Here, $a:b = 5:1$, $c:d = 7:2$.

Let the mixtures of the two containers be added together in the ratio of $x:y$.

$\therefore$ percentage quantity of milk in the new mixture

$= \left[\dfrac{\dfrac{ax}{a+b} + \dfrac{cy}{c+d}}{x+y}\right] \times 100\%$

$= \left[\dfrac{\dfrac{5x}{6} + \dfrac{7y}{9}}{x+y}\right] \times 100\% = \dfrac{45x+42y}{(x+y)} \times 100\%$

Since the percentage quantity of milk in the new mixture is 80%

$\therefore \quad \dfrac{45x+42y}{54(x+y)} \times 100\% = 80\%$

$\Rightarrow \quad (45x + 42y) \times 5 = 4 \times 54(x+y)$

$\Rightarrow \quad 225x + 210y = 216x + 216y$

$\Rightarrow \quad 9x = 6y$ or, $x:y = 2:3$.

## Exercise-2
## (Based on Memory)

1. **(a)**

| | | A | | B | | C |
|---|---|---|---|---|---|---|
| Present students | = | $6x$ | | $8x$ | | $7x$ |
| New strength | = | $6 \times 1.2x$ | | $8 \times 1.15x$ | | $7 \times 1.2x$ |
| | | $7.2x$ | | $9.2x$ | | $8.4x$ |
| New ratio | = | 72 | : | 92 | : | 84 |
| | = | 18 | : | 23 | : | 21 |

2. **(c)** Let the books distributed by a man, a woman and a child be $5x$, $4x$ and $2x$ respectively.

$\therefore$ No. of books distributed in Ist day

$= 7\times5x+5\times4x+8\times2x = 71x$

No. of books distributed in IInd day

$= 7\times5x+3\times4x+5\times2x = 57x$

And No. of books distributed in IIIrd day

$= 4\times5x+5\times4x+3\times2x = 46x$

$71x + 57x + 46x = 2000$, $x = \dfrac{2000}{174}$

$57x = \dfrac{2000}{174} \times 57 = 650$ (Approx.)

3. **(d)** Go through the options. $\dfrac{a}{9}=\dfrac{4}{b}$

$a.\ b = 9 \times 4 = 36$

4. **(b)** The required ratio

$= \dfrac{5\times130}{100}:\dfrac{6\times125}{100}:8\times\dfrac{125}{100}$

$= 650:750:1000$

$= 13:15:20$

5. **(c)** We have

20% of the first number

= 50% of the second number

$\therefore \dfrac{\text{1st number}}{\text{2nd number}}=\dfrac{50}{20}=5:2$

6. **(e)** $\dfrac{4k}{5k-100}=\dfrac{6}{7}$

or, $28k = 30k - 600$

or, $k = 300$

$\therefore 4k = 4 \times 300 = 1200$

7. **(c)** Here A:B = 125:100 = 5:4

B:C = 75:100 = 3:4

| | A | : | B | : | C |
|---|---|---|---|---|---|
| | 5 | : | 4 | | |
| | | | 3 | : | 4 |
| | 5 × 3 | : | 4 × 3 | : | 4 × 4 |
| i.e., | 15 | : | 12 | : | 16 |

$\therefore$ A's share $=\dfrac{15}{(15+12+16)}\times817=₹285$

8. **(c)** Share of B + C = $\dfrac{1872}{9-3}\times(5+8)$ = ₹4056

9. **(d)** We can not find the value without knowing any absolute value in rupees,

10. **(c)** Difference between amounts of $X$ and $Z$

$=\dfrac{11,172}{3+9}\times(13-7)=\dfrac{11,172}{12}\times6=$ ₹5586

11. **(d)** We have $\dfrac{6x+6}{7x+6}=\dfrac{15}{17}$

$\therefore$ $102x + 102 = 105x + 90$

$x=\dfrac{102-90}{3}=4$

$\therefore$ Age of Neeraj = 7 × 4 = 28 years

12. **(a)** Kiara's share $\dfrac{578}{8+12+14}\times14$ = ₹238

13. **(e)** According to the given informations.

$\dfrac{20+x}{32+x}=\dfrac{3}{4}$ or $x = 16$

Now, present strength of the social group

= 20 + 32 + 16 + 16 = 84

14. **(b)** Amit's new share

$=\dfrac{2800}{5+6+3}\times5+200=1200$

Sumit's new share = $\dfrac{2800}{14}\times6+200=1400$

Vinit's new share $=\dfrac{2800}{5+6+3}\times3+200=800$

$\therefore$ reqd. ratio = 1200:1400:800

= 6:7:4

15. **(b)** Let $x$, $y$ and $z$ be the $2r$ units

$\therefore$ $x$ = 20% of $z$, $y$ = 50% of $z$

$\Rightarrow x=\dfrac{z}{5},\ y=\dfrac{z}{2}\Rightarrow 5x=2y$

$\Rightarrow \dfrac{x}{y}=\dfrac{2}{5}$

16. **(d)** $\dfrac{A}{B}=\dfrac{3}{4}=\dfrac{30}{40},\dfrac{B}{C}=\dfrac{5}{7}=\dfrac{40}{56},\dfrac{C}{D}=\dfrac{8}{9}=\dfrac{56}{63}$

$=\dfrac{A}{D}=\dfrac{A}{B}\times\dfrac{B}{C}\times\dfrac{C}{D}=\dfrac{30}{63}=\dfrac{10}{21}$

17. **(b)** $\dfrac{a}{b}=\dfrac{5}{7},\dfrac{c}{d}=\dfrac{2a}{3b}=\dfrac{2}{3}\times\dfrac{5}{7}=\dfrac{10}{21}$

$\therefore \dfrac{ac}{bd}=\dfrac{a}{b}\times\dfrac{c}{d}=\dfrac{5}{7}\times\dfrac{10}{21}=\dfrac{50}{147}$

**18.** **(a)** Let the two numbers be $x$ and $y$.

$\therefore \quad \frac{x}{y}=\frac{2}{3} \Rightarrow \frac{x-2}{y+2}=\frac{1}{2}$

$\Rightarrow \quad 2x - 4 = y + 2$

$\Rightarrow \quad 2x - y = 6$

$\Rightarrow \quad 2\times\frac{2y}{3}-y=6$

$\Rightarrow \quad 4y - 3y = 18 \quad \therefore \quad y = 18$

$\Rightarrow \quad x = 12$

$\therefore \quad x + y + 12 + 18 = 30$

**19.** **(d)** ₹68, 000 are divided in the ratio $\frac{1}{2}:\frac{1}{4}:\frac{5}{16}$, i.e., 8:4:5.

$\therefore$ Difference of the greatest and the smallest part

$=\frac{8-4}{8+4+5}\times 68000$

$=\frac{4}{17}\times 6800=16000$

**20.** **(d)** let the tow numbers be $x, y$ and $z$.

$\therefore \quad \frac{x}{1/2}=\frac{y}{2/3}=\frac{z}{3/4}=k$

$\therefore \quad x=\frac{1}{2}k,\ y=\frac{2}{3}k,\ z=\frac{3}{4}k$

Given: $\frac{3}{4}k-\frac{1}{2}k=36 \quad \therefore \quad k = 144$

$\therefore \quad x = 72, \ y = 96, \ z = 108$

**21.** **(a)** Let $I_1$ and $I_2$ be the incomes of two persons and $E_1$, $E_2$ be their expenditure respectively.

$\therefore \quad \frac{I_1}{I_2}=\frac{5}{3},\ \frac{E_1}{E_2}=\frac{9}{5}$

and $I_1 - E_2 = 2600 \qquad \cdots(1)$

$I_2 - E_2 = 1800$

$\Rightarrow \quad \frac{3I_1}{5}-\frac{5E_1}{9}=1800$

$\Rightarrow \quad 27I_1-27E_1=1800\times 45 \qquad \cdots(2)$

$\Rightarrow \quad 27I_1-27E_1=2600\times 27 \qquad \cdots(3)$

$\therefore$ From (2) and (3), we get

$2E_1=1800\times 45-2600\times 27$

$E_1=900\times 45-1300\times 27 = 100(405 - 351) = 5400$

$\therefore \quad I_1 = 8{,}000; \ I_2 = 4800$, i.e.,

The incomes of the two persons are ₹8000 and 4800 respectively.

**22.** **(c)** Suppose 18 Kg each is melted. Ratio of gold and copper in one alloy will be 14:4 and in another 7 : 11.

$\therefore$ Ratio of gold and copper in the new alloys

$C = 14 + 7:4 + 11 = 21:15 = 7:5$.

**23.** **(c)** $\frac{x}{2y}=\frac{6}{7} \Rightarrow \frac{x}{y}=\frac{12}{7}$

$\therefore \quad \frac{x-y}{x+y}+\frac{14}{19}=\frac{\frac{x}{y}-1}{\frac{x}{y}+1}+\frac{14}{19}=\frac{\frac{12}{7}-1}{\frac{12}{7}}+\frac{14}{19}$

$=\frac{5}{19}+\frac{14}{19} = 1.$

**24.** **(c)** Annual incomes of A and B are $4k$ and $3k$, say.
Annual expenditure of A and B are $3L$ and $2L$, say.

$\therefore \quad 4k - 3L = 600$

$3k - 2L = 600$

$\Rightarrow \quad k = 600, \ L = 600$

$\therefore$ Difference in incomes of $A$ and $B$

$= 4k - 3k = k = 600.$

**25.** **(c)** $\frac{a}{b}=\frac{b}{c}=\frac{c}{b} = k$, say.

Given: $\frac{a}{b}=\frac{8}{125}=\frac{a}{b}\times\frac{b}{c}\times\frac{c}{d} = k^3$

$\Rightarrow \quad k=\frac{2}{5}$

Now, $\frac{a}{c}=\frac{a}{b}\times\frac{b}{c}=k^2=\frac{4}{25}$.

**26.** **(a)** Ratio of milk and water

$=\frac{3}{5}+\frac{7}{10}+\frac{11}{15}:\frac{2}{5}+\frac{3}{10}+\frac{4}{15}$

$=\frac{18+21+22}{30}:\frac{12+9+8}{30} = 61:29.$

**27.** **(c)** $\frac{x^2+y^2}{x^2-y^2}=\frac{\frac{x^2}{y^2}+1}{\frac{x^2}{y^2}-1}=\frac{\frac{36}{25}+1}{\frac{36}{25}-1}=\frac{\frac{61}{25}}{\frac{11}{25}}=\frac{61}{11}$.

**28.** **(a)** $\frac{a}{5}=\frac{b}{7}=\frac{c}{8} = k \Rightarrow a = 5k, \ b = 7k, \ c = 8k$

$\therefore \quad \frac{a+b+c}{a}=\frac{20k}{5k} = 4.$

**29.** **(b)** $\frac{a}{2}=\frac{b}{3}=\frac{c}{4} = k$

$\Rightarrow \quad a = 2k, \ b = 3k, \ c = 4k$

$\Rightarrow \quad \frac{1}{a}:\frac{1}{b}:\frac{1}{c}=\frac{1}{2k}:\frac{1}{3k}:\frac{1}{k4}=\frac{1}{2}:\frac{1}{3}:\frac{1}{4}.$

**30.** **(d)** $\frac{x}{8}=\frac{y}{9} = k \Rightarrow x = 8k, \ y = 9k$

$\therefore \quad \frac{5x-4y}{3x+2y}=\frac{40k-36k}{24k+18k}=\frac{4}{42}=\frac{2}{21}.$

**31.** **(a)** $x = 3k, \ y = 4k$, say

$\therefore \quad \frac{x-5}{y-5}=\frac{2}{3} \Rightarrow \frac{3k-5}{4k-5}=\frac{2}{3} \Rightarrow k = 5.$

**32.** **(a)** Suppose income of Anil and Sunil are $5k$ and $4k$, respectively.

Expenses of Anil and Sunil are $4L$ and $3L$.

$\therefore$ $5k - 4L = 1200$

$4k - 3L = 1200 \Rightarrow k = 1200, L = ₹1200$

**33.** **(b)** Let the number of one-rupee coins, 50-paise coins and 25-paise coins be $2k$, $3k$ and $5k$, respectively.

$\therefore$ $2k \times 1 + 3k \times 0.50 + 5k \times 0.25 = 114$

$\Rightarrow 2k + 1.50k + 1.25k = 114$

$\Rightarrow 4.75k = 114$

$\Rightarrow k = 24.$

**34.** **(a)** Let number of females = $F$

Suppose 160 males get ₹$16k$ and $F$ females get ₹$21k$

$\therefore$ $160 \times 4 = 16k$

$\Rightarrow k = 40$

$\therefore$ $F$ females get ₹840

$\therefore$ Number of females = $\dfrac{840}{3} = 280.$

**35.** **(c)** Let $k$ Kg of 1st variety, $k$ Kg of 2nd variety and $2k$ Kg of 3rd variety of tea are mixed.

Let price of the third variety = ₹$x$ per Kg

$\therefore$ $126k + 135k + x(2k) = 153(k + k + 2k)$

$\Rightarrow x = 175.50.$

**36.** **(c)** Let the numbers be $3k$ and $4k$

$\therefore$ $\dfrac{3k+50}{4k+50} = \dfrac{7}{9} \Rightarrow k = 100$

$\therefore$ Sum of the numbers = $7k = 700$.

**37.** **(a)** $\dfrac{A}{B} = \dfrac{5}{3}, \dfrac{B}{C} = \dfrac{6}{4} = \dfrac{2}{3}$

$\therefore$ $\dfrac{A}{C} = \dfrac{A}{B} \times \dfrac{B}{C} = \dfrac{5}{3} \times \dfrac{3}{2} = \dfrac{5}{2}.$

**38.** **(d)** Suppose A's share = ₹$3k$

B's share = ₹$4k$

C's share = ₹ $\dfrac{16}{3}$

$\therefore$ Rs 370 are divided among A, B and C in the ratio 9:12:16

$\therefore$ A's share = $\dfrac{9}{37} \times 370 = ₹90.$

**39.** **(c)** $B = \dfrac{1}{G} \Rightarrow B + G > 1$

$\therefore$ $3(B + G) > 3.$

**40.** **(d)** Let the incomes be $4k$ and $7k$ and expenses be $11L$ and $20L$, respectively.

$\Rightarrow 4k - 11L = 400$

$7k - 20L = 400$

$\Rightarrow k = 1200, L = 400$

$\therefore$ Monthly incomes are ₹4800 and ₹8400, respectively.

**41.** **(d)** $\dfrac{15-x}{19-x} = \dfrac{3}{4} \Rightarrow 60 - 4x = 57 - 3x \Rightarrow x = 3.$

**42.** **(c)** $\dfrac{p}{q} = \dfrac{r}{s} = \dfrac{t}{u} = \dfrac{2}{3}$

$$\therefore \frac{mp+nr+ot}{mq+ns+ou} = \frac{m\frac{2q}{3} + n\cdot\frac{2s}{3} + 0\cdot\frac{2u}{3}}{mq+ns+ou} = \frac{2}{3}.$$

**43.** **(d)** $\dfrac{a}{b} = \dfrac{c}{d} = \dfrac{e}{f} = \dfrac{1}{2}$

$$\Rightarrow \frac{pq+qc+re = \dfrac{\frac{pb}{2}+\frac{qd}{2}+\frac{rf}{2}}{pb+qd+rf} = \dfrac{1}{2}}{pb+qd+rf}.$$

**44.** **(a)** $\dfrac{x}{y} = \dfrac{3}{1} \Rightarrow \dfrac{x}{3} = \dfrac{y}{1} = k \Rightarrow x = 3k, y = k$

$\therefore$ $\dfrac{x^3 - y^3}{x^3 + y^3} = \dfrac{27k^3 - k^3}{27k^3 + k^3}.$

**45.** **(a)** 10% of $m$ = 20% of $n$ $\Rightarrow 10m = 20n$

$\Rightarrow \dfrac{m}{n} = \dfrac{2}{1}.$

**46.** **(a)** $2^{1.5}:2^{0.5} = 2\sqrt{2} : \sqrt{2} = 2:1.$

**47.** **(c)** If $m:n = 3:2 \Rightarrow \dfrac{m}{n} = \dfrac{3}{2} \Rightarrow m = \dfrac{3}{2}n$

then, $\dfrac{4m+5n}{4m-5n} = \dfrac{4\times\frac{3}{2}n + 5n}{4\times\frac{3}{2}n - 5n} = \dfrac{22n}{2n} = 11:1.$

**48.** **(c)** Let the two numbers be $6x$ and $7x$, respectively.

$\dfrac{6x-n}{7x-n} < \dfrac{16}{21}$ ($n$ = smallest integer)

or, $126x - 21n < 112x - 16n$

or, $14x < 5n$

$\therefore$ $n > \dfrac{14}{5}x.$

**49.** **(a)** $\dfrac{a}{b} = \dfrac{2}{3}, \dfrac{b}{c} = \dfrac{4}{5}$. Then,

$$\frac{a+b}{b+c} = \frac{\frac{2}{3}b+b}{b+\frac{5}{4}b} = \frac{\frac{5}{3}b}{\frac{9}{4}b} = \frac{5\times4}{9\times3} = \frac{20}{27}.$$

**50.** **(c)** Let the two numbers be $a$ and $b$, respectively.

Then, $a + b = 40$ and $a - b = 4$

On solving, we get $a = 22$, $b = 18$

$\therefore$ Ratio = 22:18 = 11:9.

**51.** **(a)** List price of book = $\dfrac{82\cdot50}{30} \times 100$ = ₹275

Neeta bought the book in

$275 \times 0\cdot70$ = ₹192·50.

**52.** **(b)** The man cannot purchase more than 8 bags

$\therefore$ Cost of 8 bags = 8 × 200 = ₹1600

Remaining amount = ₹(1810 – 1600) = ₹210

In ₹210, the man can purchase

$\frac{210}{70}$ = 3 bottles

$\therefore$ Required ratio = 8:3.

**53.** **(b)** We have, $\frac{a}{b}=\frac{2}{3}$ and $\frac{b}{c}=\frac{4}{5}$

$\Rightarrow \quad \frac{a}{2}=\frac{b}{3}$ and $\frac{b}{4}=\frac{c}{5}$

$\Rightarrow \quad \frac{a}{8}=\frac{b}{12}=\frac{c}{15}$

$\therefore$ $a:b:c$ = 8:12:15

$\therefore$ $a^2:b^2:bc$ = 64:144:180 = 16:36:45.

**55.** **(d)** $\frac{(7-5)(27-17)\times 40}{27\times 5-17\times 7}=\frac{2\times 10\times 40}{16}$ = 50.

**56.** **(a)** $\frac{504\times 13}{(13+11)}\div\left(\frac{504\times 11}{13+11}+12\right)$ = 91:81.

**57.** **(d)** $5x - 3y = 1800$

$6x - 4y = 1600$

Solving the two equations, we get

$x = 1200$ $\therefore$ Monthly income of B = 6 × 1200 = ₹7200.

**58.** **(d)** Required difference = $\frac{9000}{(4+5+6)}$ × (6 – 4) = 1200.

**59.** **(a)** $\frac{200\times(5\times 5-3\times 3)}{3(5+3)}=\frac{200\times 16}{3\times 8}$

$=\frac{400}{3}$ gram.

**60.** **(a)**

| A | B | C |
|---|---|---|
| 5 | 2 | |
| 7 | 13 | |

5 × 7 : 2 × 7 : 2 × 13

or, 35 : 14 : 26

Hence, share of B = $\frac{14\times 7500}{35+14+26}$

= ₹1400.

**61.** **(c)** Quantity of zinc in brass

$=\frac{7}{13+7}$ × 100 = 7 × 5 = 35 Kg.

**62.** **(c)** $A:B:C$ = 2:3:4

or, $\frac{A}{B},\frac{2}{3},\frac{B}{C}=\frac{3}{4}$ and, $\frac{C}{A}=\frac{4}{2}=2$

$\therefore \quad \frac{A}{B}:\frac{B}{C}:\frac{C}{A}=\frac{2}{3}:\frac{3}{4}:2=$ 8:9:24.

**64.** **(c)** Let the numbers be $\frac{3}{2}x$ and $\frac{8}{3}x$

$\frac{\frac{3}{2}x+15}{\frac{8}{3}x+15}=\frac{\frac{5}{3}}{\frac{5}{2}}$ or, $\frac{\frac{3x+30}{2}}{\frac{8x+45}{3}}=\frac{2}{3}$

or, $\frac{3x+30}{8x+45}\times\frac{3}{2}=\frac{2}{3}$ or, $=\frac{3x+30}{8x+45}=\frac{4}{9}$ or, $x$ = 18.

$\therefore$ greater of the numbers $=\frac{8}{3}$ × 18 = 48.

**65.** **(c)** Let the number of students in three classes be $2x$, $3x$ and $5x$

Now, according to the question

$2x + 40:3x + 40:5x + 40 = 4:5:7$

or, $\frac{2x+40}{3x+40}=\frac{4}{5}$ or, $10x + 200 = 12x + 160$

$\therefore$ $x = 20$

$\therefore$ total number of students

$= 2x + 3x + 5x = 10x = 10 \times 20 = 200$.

**66.** **(a)** Let the incomes of two persons be $5x$ and $3x$ and their expenditures be $9y$ and $5y$.

According to question

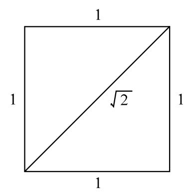
$5x - 9y = 1300$ $\cdots(1)$

$3x - 5y = 900$ $\cdots(2)$

By solving equations (1) and (2), we have $x$ = 800

$\therefore$ persons income = 5 × 800 = ₹4000 and 3 × 800 = ₹2400.

**68.** **(a)** Area of equilateral triangle with side $\sqrt{2}$




$=\frac{\sqrt{3}}{4}\times(\sqrt{2})^2=\frac{\sqrt{3}}{2}$

Area of the square with side 1 = 1

$\therefore$ Required ratio = $\sqrt{3}:2$ .

**69.** **(c)** $\frac{7x+3y}{7x-3y}=\frac{7\frac{x}{y}+3}{7\frac{x}{y}-3}$

$$=\frac{7\times\frac{3}{4}+3}{7\times\frac{3}{4}-3}=\frac{\frac{33}{4}}{\frac{9}{4}}=\frac{33}{9}=\frac{11}{3}.$$

**70.** **(b)** $\frac{a}{b}=\frac{5}{7}, \frac{c}{d}=\frac{2a}{2b}=\frac{2}{3}\times\frac{5}{7}=\frac{10}{21}$

$\therefore\ \frac{ac}{bd}=\frac{50}{147}$

$\therefore\ ac:bd = 50:147$

**71.** **(b)** $\frac{A}{B}=\frac{2}{3}, \frac{B}{C}=\frac{4}{5}, \frac{C}{D}=\frac{6}{7}$

$\therefore\ \frac{A}{16}=\frac{B}{24}=\frac{C}{30}=\frac{D}{35}$.

**72.** **(d)** Let the number be $\frac{1}{2}k, \frac{2}{3}k$ and $\frac{3}{4}k$

$\therefore\ \frac{3}{4}k-\frac{1}{2}k = 36 \ \Rightarrow\ k = 144$

$\therefore$ The numbers are 72, 96 and 108.

**73.** **(b)** Let the number of girls and boys be $4k$ and $5k$, respectively.

$\therefore\ 4k = 212 \ \Rightarrow\ k = 53$

$\therefore$ Number of boys = $5k$ = 265.

**75.** **(b)** $a:b = \frac{2}{9}:\frac{1}{3} = 2:3$

$b:c = \frac{2}{7}:\frac{5}{14} = 4:5$

$c:d = \frac{3}{5}:\frac{7}{10} = 6:7$

Now, $a:b = 2:3$

$b:c = 4:5$

$c:d = 6:7$

$\therefore\ a:b:c:d = 48:72:90:105$

$= 16:24:30:35$.

**76.** **(a)** Let the incomes of A, B and C be $7x$, $9x$ and $12x$ respectively, and the expenditures $8y$, $9y$ and $15y$, respectively. We have to find the value of

$(7x - 8y):(9x - 9y):(12x - 15y)$

Also, $7x - 8y = \frac{7x}{4}$

or, $7x - \frac{7x}{4} = 8y$

or, $\frac{x}{y}=\frac{32}{21}$

Now, $(7 \times 32 - 8 \times 21):(9 \times 32 - 9 \times 21) : (12 \times 32 - 15 \times 21) = 56:99:69$.

**77.** **(a)** Amount of copper = $\frac{5}{7} \times 17.5 = 12.5$ Kg

Amount of zinc = $\frac{2}{7} \times 17.5 = 5$

Now, the amount of zinc = 5 + 1.25 = 6.25

= 6.25 Kg

$\therefore$ Required ratio = 12.5:6.25 = 2:1.

**78.** **(a)** The ratio of number of coins

$= 13 \times \frac{100}{100}:11\times\frac{100}{50}:7\times\frac{100}{25}$

= 13:22:28

No. of 50 paise coins = $\frac{22}{63}\times 378 = 132$.

**79.** **(b)** $\frac{A}{2}=\frac{B}{3}$ and $\frac{B}{4}=\frac{C}{5} \Rightarrow \frac{A}{8}=\frac{B}{12}=\frac{C}{15}$.

**80.** **(d)** $A:B = \frac{1}{2}:\frac{1}{3} = 3:2$

$B:C = \frac{1}{2}:\frac{1}{3} = 3:2$

$\therefore\ \frac{A}{3}=\frac{B}{2}$ and $\frac{B}{3}=\frac{C}{2}$

$\Rightarrow\ \frac{A}{9}=\frac{B}{6}=\frac{C}{4}$.

**81.** **(c)** If ₹117 are divided in the ratio $\frac{1}{2}:\frac{1}{3}:\frac{1}{4}$ that is, 6:4:3 among P, Q and R, then

Share of P = ₹54

Share of Q = ₹36

Share of R = ₹27

If ₹117 are divided in the ratio of 2:3:4 among, P, Q and R, then

Share of P = ₹26

Share of Q = ₹39

Share of R = ₹52

**82.** **(d)** $17k \times 0{\cdot}10 + 6k \times 0{\cdot}25 = 112$

$\Rightarrow 1{\cdot}7k + 1{\cdot}5k = 112 \Rightarrow 3{\cdot}2k = 112 \Rightarrow k = 35$

$\therefore$ No. of 10-paise coins = $17 \times 35 = 595$

**83.** (c) $2A = 3B$

$\therefore\ \frac{A}{B}=\frac{3}{2}$ and $4B = 5C$

$\therefore\ \frac{B}{C}=\frac{5}{4}$

$\frac{A}{B}\times\frac{B}{C}=\frac{3}{2}\times\frac{5}{4}=\frac{15}{8}$

$\Rightarrow$ A:C = 15 : 8

**84.** **(a)** $\frac{x}{y}=\frac{2}{1}$ (given)

$\frac{x^2-y^2}{x^2+y^2}$

Divide numerator and denominator by $y^2$

$$\frac{\frac{x^2}{y^2}-1}{\frac{x^2}{y^2}+1}=\frac{\left(\frac{2}{1}\right)^2-1}{\left(\frac{2}{1}\right)^2+1}=\frac{\frac{4}{1}-1}{\frac{4}{1}+1}=\frac{3}{5}$$

**85.** **(c)** $I \alpha \frac{1}{R^2}$.

**86.** **(c)** 1:10 $\Rightarrow$ There must be atleast 11 marbles in the jar.

**87.** **(c)** When there are eight people, the share of each person is $\frac{1}{8}$ of the total cost.

When there are seven people, the share of each person is $\frac{1}{7}$ of the total cost.

$\therefore$ Increase in the share of each person

$$= \frac{1}{7} - \frac{1}{8} = \frac{1}{56}, \text{ i.e., } \frac{1}{7} \text{ of } \frac{1}{8}, \text{ i.e., } \frac{1}{7}$$

of the original share of each person.

**88.** **(a)** Number of people having characteristic $X$

$= 10 + 30 = 40$

Number of people having characteristic $Y$

$= 10 + 20 = 30$

Required ratio $= 40:30 = 4:3$.

**89.** **(c)** Let the first and second numbers be $x$ and $y$, respectively.

Then, $x + y = \frac{10}{3}y$ or, $x = \frac{7}{3}y$

$\therefore$ $x : y = 7 : 3$.

**90.** **(a)** Let the sums of $P$, $Q$ and $R$ be $6x$, $19x$ and $7x$

$\therefore$ Total sum $= 6x + 19x + 7x = 32x$

From the question,

$6x{:}19x + 200{:}7x - 200 = 3{:}10{:}3$

i.e. $6x = 7x - 200$

$\therefore$ $x = 200$

$\therefore$ Total sum $= 32 \times 200 =$ ₹6400.

**91.** **(c)** Let the man have ₹$x$

Amount given to his wife $= \frac{x}{2}$

Remaining $= x - \frac{x}{2} = \frac{x}{2}$

$\therefore$ Amount given to each son $= \frac{x}{2} \times \frac{2}{3} \times \frac{1}{3} = \frac{x}{9}$

$\therefore$ Amount given to each daughter

$$= \left(\frac{x}{2} - \frac{x}{3}\right) \times \frac{1}{4} = \frac{x}{24}$$

$\Rightarrow$ $\frac{x}{24} = 20000$

$\therefore$ $x =$ ₹480000

$\therefore$ Amount gives to each son

$= 480000 \times \frac{1}{9}$

$=$ ₹53333.33.

**92.** **(d)** $\frac{P}{Q} = \frac{5}{8}$ or, $P = \frac{5Q}{8}$ ···(1)

$\frac{P+4}{Q+4} = \frac{2}{3}$

or, $3P + 12 = 2Q + 8$

or, $2Q - 3P = 4$ ···(2)

Putting value of $P$ from equation (1), we get

$2Q - 3\left(\frac{5Q}{8}\right) = 4$

$\Rightarrow$ $Q = 32$ years.

**93.** **(b)** $\frac{P}{Q} = \frac{5}{7}$ or, $Q = \frac{7P}{5}$

**Case I**: $Q - (P + 6) = 2$ or, $Q = P + 8$

$\therefore$ $\frac{7P}{5} = P + 8$ or, $7P = 5P + 40$

$\therefore$ $P = 20$ and $Q = \frac{7}{5} \times 20$

$Q = 28$

$\therefore$ $P + Q = 20 + 28 = 48$ years.

**Case II**: $(P + 6) - Q = 2$

or, $P + 6 - \frac{7}{5}P = 2$ or, $P = 10$ and $Q = 14$

$\therefore$ $P + Q = 10 + 14 = 24$ years.

**94.** **(d)** P:Q:R = 5:8:12

$$\frac{\text{Total share of Q and R}}{\text{share of P}} = \frac{8+12}{5} = \frac{20}{5} = 4.$$

Thus, we see that no new information has been given in the question and therefore P's share cannot be determined.

**95.** **(b)** Ratio A:B = 3:2

and A:C = 2:1

$\therefore$ A:B:C = 6:4:3

Profit share of B $= \frac{4}{13} \times 1{,}57{,}300 =$ ₹48400.

**96.** **(d)** Here, neither the total amount nor the individual amount is given. So the share of Q cannot be determined.

**97.** **(b)** 30% of I + II = II $\times \frac{120}{100}$

or, $\frac{3}{10}\text{I} + \text{II} = \frac{12}{10}\text{II}$

or, $\frac{3}{10}\text{I} = \frac{2}{10}\text{II}$

$\Rightarrow$ I:II = 2:3.

**98.** **(a)** Let the salaries of A and B be $9x$ and $4x$.

$9x \times \frac{115}{100} = 5175$

$\therefore$ $x = 500$

$\therefore$ Salary of B $= 500 \times 4 =$ ₹2000

**99.** **(c)** Sohan − Mohan = 10 ···(1)

$$\frac{\text{Mohan} - 5}{\text{Sohan} - 5} = \frac{1}{2}$$

$\Rightarrow$ 2 Mohan − Sohan = 5 ···(2)

On solving (1) and (2), we get

Mohan = 15 years and Sohan = 25 years.

**100. (b)** $$\frac{P}{Q} = \frac{7}{3}$$

$$\Rightarrow \quad Q = \frac{3P}{7} \quad \cdots(1)$$

and, $$\frac{P+4}{Q+4} = \frac{2}{1}$$

or, $P + 4 = 2Q + 8$

or, $2Q = P - 4 \quad \cdots(2)$

Solving equations (1) and (2), we get

$P = 28$ years.

**101. (b)** Required difference between Monu's and Raju's shares

$$= \frac{3-2}{2+3+5} \times 125000 = ₹12500.$$

**102. (b)** Ram Shyam

7 8

4 9 10

Present age of Ram $= \dfrac{4\times(10-9)}{9\times 8-10\times 7} \times 7$

$= 14$ years.

**103. (d)** Suppose the salaries of A, B and C were 300 $k$, 500 $k$ and 700 $k$, respectively.

After increment, salary of

A = 300 $k$ + 50% of 300 $k$ = 450 $k$

B = 500 $k$ + 50% of 500 $k$ = 800 $k$

C = 700 $k$ + 50% of 700 $k$ = 1050 $k$

Hence, new ratio of the respective salaries of A, B and C = 450 $k$:800 $k$:1050 $k$ = 9:16:21.

**104. (d)** let A's income, B's income, C's income and be ₹$7x$, ₹$9x$ and ₹$12x$, respectively and their expenditures be ₹$8y$, ₹$9y$ and ₹$15y$ respectively.

Therefore,

$$7x - 8y = \frac{7x}{4}$$

$\Rightarrow \quad 4(7x - 8y) = 7x$

$\Rightarrow \quad 28x - 32y = 7x$

$\Rightarrow \quad 28x - 7x = 32y$

$\Rightarrow \quad 21x = 32y$

$$\Rightarrow \quad y = \frac{21x}{32}$$

A's saving $= \dfrac{7x}{y}$

B's saving $= 9x - 9y$

$$= 9\left(x - \frac{21x}{32}\right) = 9\left(\frac{32x}{32} - 21x\right)$$

$$= \frac{9\times 11x}{32} = \frac{99x}{32}$$

C's saving $= 12x - 15y$

$$= 12x - \frac{15\times 21x}{32} = \frac{69x}{32}$$

Hence, the required ratio

$$= \frac{7x}{4};\frac{99x}{32};\frac{69x}{32}$$

= 56; 99; 69

**105. (c)** Let $k$ be the third proportional of 38 and 15

38:15::15:$k$

$$\Rightarrow \quad k = \frac{15\times 15}{38}.$$

**106. (c)** Let the amount of P, Q, R be ₹$3x$, ₹$5x$ and ₹$7x$, respectively.

$\because \quad 7x - 5x = 4000$

$x = 2000$

$\therefore$ Total amount received by $P$ and $Q$ together

$= (3 + 5) \times ₹2000$

$= ₹16000$

**107. (b)** A:B:C = 5:4:7

After increasing ratio $= 5 \times \dfrac{120}{100} : 4 \times \dfrac{125}{100} : 7 \times \dfrac{120}{100}$

= 600:500:840

= 30:25:42

**108. (c)** Suppose the number of sweets is $= x$.

$$\therefore \quad \frac{x}{450-150} - \frac{x}{450} = 3$$

$$\frac{x}{300} - \frac{x}{450} = 3$$

$$\frac{3x-2x}{900} = 3$$

$x = 2700$

Number of sweets to each children

$$= \frac{2700}{300} = 9$$

**109. (c)** $$\frac{x}{2y} = \frac{6}{7} \quad \Rightarrow \quad \frac{x}{y} = \frac{12}{7}$$

$$\therefore \quad \frac{x-y}{x+y} + \frac{14}{19} = \frac{\frac{x}{y}-1}{\frac{x}{y}+1} + \frac{14}{19} = \frac{\frac{12}{7}-1}{\frac{12}{7}} + \frac{14}{19}$$

$$= \frac{5}{19} + \frac{14}{19} = 1.$$

**110. (c)** Annual incomes of A and B are $4k$ and $3k$, say.

Annual expenditure of A and B are $3L$ and $2L$, say.

$\therefore \quad 4k - 3L = 600$

$3k - 2L = 600$

$\Rightarrow \quad k = 600, L = 600$

$\therefore$ Difference in incomes of A and B

$= 4k - 3k = k = 600.$

**111.** **(c)** $\frac{a}{b} = \frac{b}{c} = \frac{c}{d} = k$, say.

Given: $\frac{a}{d} = \frac{8}{125}$

$= \frac{a}{b}\times\frac{b}{c}\times\frac{c}{d} = k^3$

$\Rightarrow k = \frac{2}{5}$

Now, $\frac{a}{c} = \frac{a}{b}\times\frac{b}{c} = k^2 = \frac{4}{25}$.

**112.** **(a)** Ratio of milk and water

$= \frac{3}{5}+\frac{7}{10}+\frac{11}{15}:\frac{2}{5}+\frac{3}{10}+\frac{4}{15}$

$= \frac{18+21+22}{30}:\frac{12+9+8}{30}$

$= 61:29.$

**113.** **(c)** Total consumption of electricity

$= (10 \times 16 \times 8 + 3 \times 10 \times 8)$ units

$= (1280 \times 240)$ units

$= 1520$ units

**114.** **(a)** Suppose income of Anil and Sunil are $5k$ and $4k$, respectively.

Expenses of Anil and Sunil are $4L$ and $3L$.

$\therefore$ $5k - 4L = 1200$

$4k - 3L = 1200$

$\Rightarrow k = 1200, L =$ ₹1200

**115.** **(a)** Speed of the Tractor $= \frac{360}{12} = 30$ Km/h

Speed of the Jeep $= 30\times\frac{250}{100} = 75$ Km/h

Speed of the Car $= \frac{3}{5}\times 75 = 45$ Km/h

Average speed of Car and Jeep together

$= \frac{75+45}{2} = 60$ Km/h

**116.** **(a)** Let number of females $= F$

Suppose 160 males get ₹16 $k$ and $F$ females get ₹21 $k$

$\therefore$ $160 \times 4 = 16k$

$\Rightarrow k = 40$

$\therefore$ $F$ females get ₹840

$\therefore$ Number of females $= \frac{840}{3} = 280.$

**117.** **(c)** Let $k$ Kg of 1st variety, $k$ Kg of 2nd variety and $2k$ Kg of 3rd variety of tea are mixed.

Let price of the third variety = ₹$x$ per Kg

$\therefore$ $126k + 135k + x(2k) = 153(k + k + 2k)$

$\Rightarrow x = 175.50.$

**118.** **(a)** Total = 950 coins

Ratio of coins before $= (20x + 25):(73x + 15):(83x + 30)$ (Lalita:Amita:Neeta)

Now, $20x + 25 + 73x + 15 + 83x + 30 = 950$

$\therefore$ $176x = 880$ $\therefore$ $x = 5$

$\therefore$ Amita $= 73x + 15$

$= 73 \times 5 + 15 = 380$ coins

**119.** **(d)** Suppose first number is $x$ and second number is $y$.

$y = 0.3x = \frac{4}{5}y$

$y - 0.8y = 0.3x$

$0.2y = 0.3\,x$

$\frac{x}{y} = \frac{2}{3}$

**120.** **(d)** Suppose A's share = ₹$3k$

B's share = ₹$4k$

C's share = ₹$\frac{16}{3}$

$\therefore$ ₹370 are divided among A, B and C in the ratio 9:12:16

$\therefore$ A's share $= \frac{9}{37}\times 370 =$ ₹90.

**121.** **(c)** $\frac{p}{q} = \frac{r}{s} = \frac{t}{u} = \frac{2}{3}$

$$\therefore \quad \frac{mp+nr+ot}{mq+ns+ou} = \frac{m\frac{2q}{3}+n\frac{2s}{3}+o\frac{2u}{3}}{mq+ns+ou} = \frac{2}{3}.$$

**122.** **(a)** List price of book $= \frac{82\cdot 50}{30}\times 100 =$ ₹275

Neeta bought the book in

$275 \times 0.70 =$ ₹192.50.

**123.** **(b)** The man cannot purchase more than 8 bags

$\therefore$ Cost of 8 bags $= 8 \times 200 =$ ₹1600

Remaining amount = ₹$(1810 - 1600)$ = ₹210

In ₹210, the man can purchase

$\frac{210}{70} = 3$ bottles

$\therefore$ Required ratio = 8:3.

**124.** **(b)** We have $\frac{a}{b} = \frac{2}{3}$ and, $\frac{b}{c} = \frac{4}{5}$

$\Rightarrow \frac{a}{2} = \frac{b}{3}$ and, $\frac{b}{4} = \frac{c}{5}$

$\Rightarrow \frac{a}{8} = \frac{b}{12} = \frac{c}{15}$

$\therefore$ $a:b:c = 8:12:15$

$\therefore$ $a^2:b^2:bc = 64:144:180$

$= 16:36:45.$

**125. (a)** $\dfrac{200\times(5\times5-3\times3)}{3(5+3)} = \dfrac{200\times16}{3\times8}$

$= \dfrac{400}{3}$ gram.

**126. (a)**

| A | | B | | C |
|---|---|---|---|---|
| 5 | | 2 | | |
| 7 | | 13 | | |
| 5 × 7 | : | 2 × 7 | : | 2 × 13 |
| or, 35 | : | 14 | : | 26 |

Hence, share of B $= \dfrac{14\times7500}{35+14+26}$

= ₹1400.

**127. (c)** Let the numbers be $\dfrac{3}{2}x$ and $\dfrac{8}{3}x$

$\dfrac{\frac{3}{2}x+15}{\frac{8}{3}x+15} = \dfrac{\frac{5}{3}}{\frac{5}{2}}$, or, $\dfrac{\frac{3x+30}{2}}{\frac{8x+45}{3}} = \dfrac{2}{3}$

or, $\dfrac{3x+30}{8x+45}\times\dfrac{3}{2} = \dfrac{2}{3}$ or, $\dfrac{3x+30}{8x+45} = \dfrac{4}{9}$ or, $x = 18$.

$\therefore$ greater of the numbers $= \dfrac{8}{3}\times 18 = 48$.

**128. (c)** Let, the number of students in three classes be $2x$, $3x$ and $5x$.

Now, according to the question

$2x + 40:3x + 40:5x + 40 = 4:5:7$

or, $\dfrac{2x+40}{3x+40} = \dfrac{4}{5}$

or, $10x + 200 = 12x + 160$

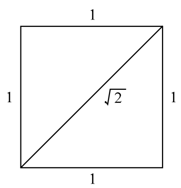
$\therefore$ $x = 20$

$\therefore$ Total number of students

$= 2x + 3x + 5x = 10x$

$= 10 \times 20 = 200$.

**129. (a)** Area of equilateral triangle with side $\sqrt{2}$




$= \dfrac{\sqrt{3}}{4}\times(\sqrt{2})^2 = \dfrac{\sqrt{3}}{2}$

Area of the square with side 1 = 1

$\therefore$ Required ratio $= \sqrt{3}:2$ .

**130. (d)** Let, the number be $\dfrac{1}{2}k$, $\dfrac{2}{3}k$ and $\dfrac{3}{4}k$

$\therefore$ $\dfrac{3}{4}k-\dfrac{1}{2}k = 36 \Rightarrow k = 144$

$\therefore$ The numbers are 72, 96 and 108.

**131. (b)** $a:b = \dfrac{2}{9}:\dfrac{1}{3} = 2:3$

$b:c = \dfrac{2}{7}:\dfrac{5}{14} = 4:5$

$c:d = \dfrac{3}{5}:\dfrac{7}{10} = 6:7$

Now, $a:b = 2:3$

$b:c = 4:5$

$c:d = 6:7$

$\therefore$ $a:b:c:d = 48:72:90:105$

$= 16:24:30:35$.

**132. (a)** Let, the incomes of A, B and C be $7x$, $9x$ and $12x$ respectively, and the expenditures $8y$, $9y$ and $15y$, respectively. We have to find the value of

$(7x - 8y):(9x - 9y):(12x - 15y)$

Also, $7x - 8y = \dfrac{7x}{4}$ or, $7x - \dfrac{7x}{4} = 8y$

or, $\dfrac{x}{y} = \dfrac{32}{21}$

Now, $(7 \times 32 - 8 \times 21):(9 \times 32 - 9 \times 21)$ $:(12 \times 32 - 15 \times 21) = 56:99:69$.

**133. (a)** Amount of copper $= \dfrac{5}{7} \times 17.5 = 12.5$ Kg

Amount of zinc $= \dfrac{2}{7} \times 17.5 = 5$

Now, the amount of zinc = 5 + 1.25

= 6.25 = 6.25 Kg

$\therefore$ Required ratio = 12.5:6.25 = 2:1.

**134. (c)** If ₹117 are divided in the ratio $\dfrac{1}{2}:\dfrac{1}{3}:\dfrac{1}{4}$ that is, 6:4:3 among P, Q and R, then

Share of P = ₹54

Share of Q = ₹36

Share of R = ₹27

If ₹117 are divided in the ratio of 2:3:4 among, P, Q and R, then

Share of P = ₹26

Share of Q = ₹39

Share of R = ₹52

**135. (a)** Son : wife = 3:1 = 9:3

Wife : daughter = 3:1

$\therefore$ Son : wife : daughter = 9:3:1

Sum of ratios = 9 + 3 + 1 = 13

Let, total wealth be ₹$x$.

$\therefore$ Son's share – daughter's share = ₹10,000

$\Rightarrow$ $\dfrac{9x}{13} - \dfrac{x}{13} = 10000$

$\Rightarrow \quad \frac{9x-x}{13} = 10000$

$\Rightarrow \quad 8x = 130000$

$\Rightarrow \quad \frac{130000}{8} = ₹16250$

**136.** **(c)** Boys = $x$, Girls = $z - x$

$\therefore$ Part of girls $= \frac{z-x}{z} = 1 - \frac{x}{z}$

**137.** **(c)** Let the third proportional of 12 and 18 be $x$.

Now, according to the question,

12:18 = 18:$x$

$\Rightarrow \quad x = \frac{18 \times 18}{12} = 27$

**138.** **(a)** Marks in English = $2x$

Marks in Mathematics = $3x$

Marks in Science = $x$

Now, according to the question,

$x + 2x + 3x = 180$

$\Rightarrow \quad 6x = 180 \quad \Rightarrow \quad x = 30$

**139.** **(b)** Let the numbers be $2x$, $3x$ and $4x$.

Now, according to the question,

$(2x)^2 + (3x)^2 + (4x)^2 = 1856$

$\Rightarrow \quad 4x^2 + 9x^2 + 16x^2 = 1856$

$\Rightarrow \quad 29x^2 = 1856 \quad \Leftrightarrow \quad x^2 = 1856 \div 29 = 64$

$\therefore \quad x = \sqrt{64} = 8$

$\therefore \quad$ Numbers = 16, 24 and 32

**140.** **(b)** Let $x$:$y$ = 3:2 = 9:6 and

$y$:$z$ = 3:2 = 6:4

$\therefore \quad x$:$y$:$z$ = 9:6:4

Now, according to the question,

$9a + 6a + 4a = 342$

$\Rightarrow \quad 19a = 342 \quad \Leftrightarrow \quad a = 342 \div 19 = 18$

$\therefore \quad \text{A} \Rightarrow 18 \times 9 = 162$

$\text{B} \Rightarrow 18 \times 6 = 108$

$\text{C} \Rightarrow 18 \times 4 = 72$

**141.** **(c)** $\text{A} \times \frac{1}{2} = \text{B} \times \frac{1}{3} = \text{C} \times \frac{1}{4}$

$\Rightarrow \quad \frac{\text{A}}{2} = \frac{\text{B}}{3} = \frac{\text{C}}{4} \quad \Leftrightarrow \quad \text{A:B:C} = 2:3:4$

$\therefore \quad \text{A} \Rightarrow \frac{2}{9} \times 900 = ₹200$

$\text{B} \Rightarrow \frac{3}{9} \times 900 = ₹300$

$\text{C} \Rightarrow \frac{4}{9} \times 900 = ₹400$

**142.** **(c)** A:B:C = 2:5:4

Sum of ratios = 2 + 5 + 4 =11

$\therefore$ Required difference $= \left(\frac{5}{11} - \frac{2}{11}\right) \times 126.50$

$= \frac{3}{11} \times 126.50 = ₹34.50$

**143.** **(b)** Number of one-rupee coins = $x$

Number of 50-paise coins = $4x$

Number of 25-paise coins = $2x$

$\therefore$ Ratio of their values $= x : \frac{4x}{2} : \frac{2x}{4} = 2:4:1$

$\therefore$ Value of 50-paise coins $= \frac{4}{2+4+1} \times 56$

$= \frac{4}{7} \times 56 = ₹32$

$\therefore$ Their number = 32 × 2 = 64

**144.** **(b)** Let the original number of students be $4x$, $6x$ and $9x$.

Now, according to the question,

$\frac{4x+12}{6x+12} = \frac{7}{9}$

$\Rightarrow \quad 42x + 84 = 36x + 108$

$\Rightarrow \quad 42x - 36x = 108 - 84$

$\Rightarrow \quad 6x = 24$

$\Rightarrow \quad x = 4$

$\therefore$ Required number of students = $4x + 6x + 9x$

$= 19x = 19 \times 4 = 76$

**145.** **(a)** Let the numbers be $5x$ and $4x$

Now, according to the question,

$5x \times \frac{40}{100} = 12$

$\Rightarrow \quad 2x = 12$

$\Rightarrow \quad x = 6$

$\therefore$ Second number = $4x$ = 6 × 4 = 24

$\therefore$ 50% of 24 $= 24 \times \frac{50}{100} = 12$

**146.** **(d)** Amit's income = ₹$3x$ and his expenditure = ₹$5y$

Veeri's income = ₹$2x$ and his expenditure = ₹$3y$

$\therefore \quad 3x - 5y = 2x - 3y$

$\Rightarrow \quad x = 2y$

$\therefore \quad 3x - 5y = 1000$

$\Rightarrow \quad 6y - 5y = 1000 \quad \Rightarrow \quad y = 1000$

$\therefore \quad x = 2000$

$\therefore$ Amit's income = $3x$ = ₹(3 × 2000)

= ₹6000

**147.** **(c)** $P\alpha\dfrac{1}{QR}$

$\Rightarrow PQR = k$ (constant)

$\Rightarrow k = 75 \times 6 \times 12$

$\Rightarrow PQR = 75 \times 6 \times 12$

When, $Q = 5$ and $R = 10$, then

$P \times 5 \times 10 = 75 \times 6 \times 12$

$\Rightarrow \quad p = \dfrac{75\times 6\times 12}{5\times 10} = 108$

**148.** **(b)** $8 \times A = B \times 12 = 6 \times C$

$\Rightarrow \quad \dfrac{8A}{24} = \dfrac{12B}{24} = \dfrac{6C}{24}$

$\Rightarrow \quad \dfrac{A}{3} = \dfrac{B}{2} = \dfrac{C}{4}$

$\therefore$ A:B:C = 3:2:4

$\therefore$ B's share $= ₹\left(\dfrac{2}{3+2+4}\times 864\right)$

$= ₹\left(\dfrac{2}{9}\times 864\right) = ₹192$

**149.** **(b)** Women $= \dfrac{43}{83}\times 311250 = 161250$

Men = 311250 − 161250 = 150000

$\therefore$ Total number of literate persons

$= \dfrac{161250\times 8}{100} + 150000\times\dfrac{24}{100}$

= 12900 + 36000 = 48900

**150.** **(a)** Let the incomes of A and B be ₹$2x$ and ₹$x$ respectively and their expenditures be ₹$5y$ and ₹$3y$ respectively.

A's savings $= \dfrac{4}{5}\times 5000 = ₹4000$

B's savings = ₹1000

$\therefore \quad 2x - 5y = 4000 \qquad \cdots(1)$

$x - 3y = 1000 \qquad \cdots(2)$

By equation (1) × 3 − equation (2) × 5, we have

$6x - 15y - (5x - 15y) = 12000 - 5000 = 7000$

$\Rightarrow \quad 6x - 5x = 7000$

$\Rightarrow \quad x = ₹7000$

**151.** **(b)** Let the numbers be $x$ and $y$, where $x > y$

Now, according to the question,

$\dfrac{x+y}{x-y} = \dfrac{5}{1}$

(By componendo and dividendo)

$\Rightarrow \quad \dfrac{x+y+x-y}{x+y-x+y} = \dfrac{5+1}{5-1}$

$\Rightarrow \quad \dfrac{x}{y} = \dfrac{6}{4} = \dfrac{3}{2}$

**152.** **(b)** Let the initial number of employees be $9x$ and the employer gives ₹$14y$ as wage to each.

Now, according to the question,

$9x \times 14y = 18900$

$\Rightarrow \quad xy = \dfrac{18900}{9\times 14} = 150$

and the later bill $= 8x \times 15y = 120xy$

= 120 × 150 = 18000

$\therefore$ required ratio = 18000:18900 = 20:21

**Quicker Method**:

Required ratio = 9 × 14:8 × 15

= 21:20

**153.** **(b)** $\because$ A + B + C = 1050

$\Rightarrow$ (B + C) = (1050 − A) According to the question,

$\Rightarrow \text{A} = (\text{B}+\text{C})\dfrac{2}{5} = (1050-\text{A})\dfrac{2}{5}$

$\Rightarrow$ 5A = 2 (1050 − A)

$\Rightarrow$ 7A = 2100

$\therefore$ Share of A = ₹300

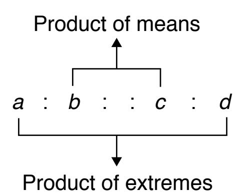
**154.** **(b)** $\therefore \quad \dfrac{A}{B} = \dfrac{2}{3}, \dfrac{B}{C} = \dfrac{4}{5}, \dfrac{C}{D} = \dfrac{5}{9}$

$\therefore \dfrac{A}{D} = \dfrac{A}{B}\times\dfrac{B}{C}\times\dfrac{C}{D} = \dfrac{2}{3}\times\dfrac{4}{5}\times\dfrac{5}{9} = \dfrac{8}{27}$

A:D = 8:27

**(155-159)**. Boys $= \dfrac{7}{15}\times 150 = 70$; Girls $= \dfrac{8}{15}\times 150 = 80$

| | Boy | Girl |
|---|---|---|
| Marketing, $n(M)$ | 28 | 40 |
| HR, $n(M)$ | 21 | 24 |
| Finance, $n(F)$ | 21 | 16 |
| HR + Marketing, $n(H \cap M)$ | 7 | 9 |
| HR + Finance, $n(H \cap F)$ | 6 | 7 |
| Marketing + Finance, $n(M \cap F)$ | 5 | 8 |
| Marketing + Finance + HR, $n(M \cap F \cap H)$ | 2 | 3 |




**155.** **(a)** Requried% $= \dfrac{5}{150}\times 100 = 3.33\%$

**156.** **(b)** Required ratio = 18:26 = 9:13

**157.** **(c)** Required ratio = 5:4

**158.** **(d)** Required percentage $= \dfrac{28-24}{24}\times 100 = \dfrac{4}{24}\times 100 = 16\dfrac{2}{3}\%$

**159.** **(a)** Required ratio = 10:11

**160.** **(e)** Let $x$ be subtracted from the numbers 9, 15 and 27 we get continue proportion.

Now, $(9 - x):(15 - x):(27 - x)$

$\therefore \ b^2 = ac$

$\Rightarrow (15 - x)^2 = (9 - x)(27 - x)$

or, $225 - 30x + x^2 = 243 + x^2 - 36x$

or, $6x = 243 - 225 = 18$

$\therefore \ x = 3$

Hence, number become $9 - x = 9 - 3 = 6$

$15 - x = 15 - 3 = 12$

and, $27 - x = 27 - 3 = 24$

$\therefore$ 6:12:24 = 1:2:4

Thus 1:2:4 is continued proportion.

**161.** **(a)** Let the amount be $x$.

Then, B's share $= \dfrac{3x}{9}$

Due to error B's share $= \dfrac{2x}{14}$

Difference in B's share due to error = 40

$\dfrac{3x}{9} - \dfrac{2x}{14} = 40$

or, $\dfrac{42x - 18x}{126} = 40$ or, $24x = 40 \times 126$

$\therefore \ x = \dfrac{40\times 126}{24} = ₹210$

**162.** **(e)** Let, A's share be $4x$ and B's share be $7x$.

$\therefore \ 4x + 7x = 73689$

or, $11x = 73689$

$\therefore \ x = \dfrac{73689}{11} = 6699$

A's share = 6699 × 4 = 26796

B's share = 6699 × 7 = 44893

Thrice the share of $A$ = 26796 × 3 = 80388

Twice the share of $B$ = 46893 × 2 = 93786

Difference = 93786 − 80388 = ₹13398

**163.** **(e)** Using Statement I:

$\dfrac{A}{B} = \dfrac{2}{3}$

Using Statement II:

$A$ is 40% of total. So $B$ is 60% of total amount invested.

$\dfrac{A}{B} = \dfrac{40}{60} = \dfrac{2}{3}$

Using Statement III:

$A = 45000$

Putting the value of Statement III in any of the Statements I or II,

we can find the amount invested in scheme $B$.

**164.** **(e)** Let, $x$ boys and $x$ girls join the group of 20 boys and 32 girls to make the ratio 3:4. So,

$\dfrac{20+x}{32+x} = \dfrac{3}{4} = 80 + 4x = 96 + 3x$

$\Rightarrow \ x = 16$

Total number of people in the group will be 20 + 32 + 16 + 16 = 84

**165.** **(d)** Let, the number be $x$.

$\therefore$ 53% of $x$ = 676 − 358 = 318

$\therefore \ x = 600$

$\therefore$ 23% of $x$ = 138

$\therefore$ three-fourths of $138 = 138 \times \dfrac{3}{4} = 103.5$

**166.** **(e)** Let, their present ages be $13x$ and $17x$.

Then, $\dfrac{13x-4}{17x-4} = \dfrac{11}{15}$. Solving this, we get:

Required ratio $= \dfrac{13\times 2+6}{17\times 2+6} = \dfrac{32}{40} = \dfrac{4}{5}$

**167.** **(e)** Let, the two numbers be $x$ and $y$.

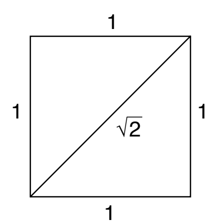
Then $Y - \dfrac{30}{100}\times = \dfrac{4}{5}Y$

$\Rightarrow \ \dfrac{Y}{5} = \dfrac{3}{10}X$

$\Rightarrow \ \dfrac{X}{Y} = \dfrac{2}{3}.$

**(168–172):**

| Female | Games | Male |
|---|---|---|
| 48 | Athletics | 165 |
| 16 | Table Tennis | 165 |
| 24 | Kho-Kho | 99 |
| 72 | Lawn Tennis | 11 |




**168.** **(c)** Required ratio = 11:16

**169.** **(e)** 48 + 165 + 16 + 165 = 394

**170.** **(d)** Required ratio = 72:16 = 9:2

**171.** **(a)** 99 − 72 = 27

# Partnership

# 8

## INTRODUCTION

In *partnership*, two or more persons carry on a business and share the profits of the business at an agreed proportion. Persons who have entered into partnership with one another are individually called *partners* and collectively called a *firm*. The name under which their business is carried on is called the *firm name*. The partnership may be simple or compound type.

**Simple Partnership** is one in which the cmesapital of each partner is invested in the business for certain timespan.

**Compound Partnership** is one in which the capitals of the partners are invested for different time periods.

Again, a partner may be a working partner or a sleeping partner.

**A Sleeping Partner** is one who invests the capital in the business, but does not actively participate in the day-to-day activities of the business.

**A Working Partner** besides investing capital, takes part in running the business. For his work, he is either paid certain amount of salary and also share of profit.

## SOME BASIC FORMULAE

1. (a) If capitals of two partners be ₹$C_1$ and ₹$C_2$ for the same period and the total profit be ₹$P$, then shares of the partners in the profit are

$$₹\left(\frac{C_1 \times P}{C_1 + C_2}\right) \text{ and } ₹\left(\frac{C_2 \times P}{C_1 + C_2}\right).$$

(b) If the capitals of three partners be ₹$C_1$, ₹$C_2$ and ₹$C_3$ for the same period, and the total profit be ₹$P$, then shares of the partners in the profit are

$$₹\left(\frac{C_1 \times P}{C_1 + C_2 + C_3}\right), ₹\left(\frac{C_2 \times P}{C_1 + C_2 + C_3}\right)$$

$$\text{and } ₹\left(\frac{C_3 \times P}{C_1 + C_2 + C_3}\right).$$

**Illustration 1:** A, B and C invested ₹20,000, ₹50,000 and ₹40,000, in a business. The net profit for the year was ₹12,100. This *T* which was divided in proportion to investments. Find out the amount of profit each partner has earned.

**Solution:** We have, $C_1 = 20{,}000$, $C_2 = 50{,}000$, $C_3 = 40{,}000$ and $P = 12{,}100$.

Therefore, profit share of *A*:

$$= \frac{C_1 \times P}{C_1 + C_2 + C_3}$$

$$= \frac{20{,}000 \times 12{,}100}{20{,}000 + 50{,}000 + 40{,}000}$$

$$= \frac{2}{11} \times 12{,}100 = ₹2{,}200.$$

Profit share of *B*:

$$= \frac{C_2 \times P}{C_1 + C_2 + C_3}$$

$$= \frac{50{,}000 \times 12{,}100}{20{,}000 + 50{,}000 + 40{,}000}$$

$$= \frac{5}{11} \times 12{,}100 = ₹5{,}500.$$

Profit share of *C*:

$$= \frac{C_3 \times P}{C_1 + C_2 + C_3}$$

$$= \frac{40{,}000 \times 12{,}100}{20{,}000 + 50{,}000 + 40{,}000}$$

$$= \frac{4}{11} \times 12{,}100 = ₹4{,}400.$$

2. (a) If the capitals of two partners be ₹$C_1$ and ₹$C_2$ for the periods $t_1$ and $t_2$, and the total profit be ₹$P$, then shares of the partners in the profits are:

$$₹\left(\frac{C_1 \times t_1 \times P}{C_1t_1 + C_2t_2}\right) \quad \text{and} \quad ₹\left(\frac{C_2 \times t_2 \times P}{C_1t_1 + C_2t_2}\right)$$

(b) If the capitals of three partners be ₹$C_1$, ₹$C_2$ and ₹$C_3$ for the periods $t_1$, $t_2$ and $t_3$, respectively, and the total profit be ₹$P$, then shares of the partners in the profit are

$$₹\left(\frac{C_1 \times t_1 \times P}{C_1t_1 + C_2t_2 + C_3t_3}\right), ₹\left(\frac{C_2 \times t_2 \times P}{C_1t_1 + C_2t_2 + C_3t_3}\right),$$

and $$₹\left(\frac{C_3 \times t_3 \times P}{C_1t_1 + C_2t_2 + C_3t_3}\right)$$

**Illustration 2:** A and B are two partners in a business. A contributes ₹1,200 for 5 months and B contributes ₹750 for 4 months. If total profit is ₹450, find out their respective shares.

**Solution:** We have, $C_1 = 1200$, $C_2 = 750$, $t_1 = 5$, $t_2 = 4$ and $P = 450$.

∴ Profit share of A

$$= \frac{C_1 \times t_1 \times P}{C_1t_1 + C_2t_2} = \frac{1,200 \times 5 \times 450}{1,200 \times 5 + 750 \times 4}$$

$$= \frac{27,00,000}{9,000} = ₹300.$$

Profit share of B

$$= \frac{C_2 \times t_2 \times P}{C_1t_1 + C_2t_2}$$

$$= \frac{750 \times 4 \times 450}{1,200 \times 5 + 750 \times 4}$$

$$= \frac{13,50,000}{9,000} = ₹150.$$

## SOME USEFUL SHORTCUT METHODS

1. (a) If the capitals of two partners be ₹$C_1$ and ₹$C_2$ for the periods $t_1$ and $t_2$ respectively, then

$$\frac{\text{Profit of A}}{\text{Profit of B}} = \frac{C_1 \times t_1}{C_2 \times t_2}.$$

(b) If the capitals of three partners be ₹$C_1$, ₹$C_2$ and ₹$C_3$ for the periods $t_1$, $t_2$ and $t_3$ respectively, then profit of A: profit of B: profit of C = $C_1 \times t_1 : C_2 \times t_2 : C_3 \times t_3$.

*Note:*

If there is a loss in the business, then

Loss of A : Loss of B : Loss of C

$= C_1 \times t_1 : C_2 \times t_2 : C_3 \times t_3$.

**Illustration 3:** There are three partners A, B and C in a business. A invests ₹2000 for 5 months, B invests ₹1200 for 6 months and C invests ₹2500 for 3 months. Find out the ratio of their shares in the profit.

**Solution:** Here, $C_1 \times t_1 = 2,000 \times 5 = 10,000$, $C_2 \times t_2 = 1,200 \times 6 = 7,200$ and $C_3 \times t_3 = 2,500 \times 3 = 7,500$.

∴ Profit of A: Profit of B: Profit of C

$= C_1 \times t_1 : C_2 \times t_2 : C_3 \times t_3$

$= 10,000:7,200:7,500$ or $100:72:75$.

2. If the capitals of three partners in a business invested in the ratio of $C_1:C_2:C_3$ and their profits are in the ratio $P_1:P_2:P_3$, then the ratio of timing of their investments $= \frac{P_1}{C_1} : \frac{P_2}{C_2} : \frac{P_3}{C_3}$.

**Illustration 4:** Anu, Manu and Tanu invested capitals in a business the ratio 4:6:9. At the end of the business, they received their shares of profits in the ratio 2:3:5. Find the ratio of time for which they invested their capitals.

**Solution:** We have $C_1:C_2:C_3 = 4:6:9$

and $P_1:P_2:P_3 = 2:3:5$

Therefore, the ratio of time for which Anu, Manu and Tanu invested their capitals

$$= \frac{P_1}{C_1} : \frac{P_2}{C_2} : \frac{P_3}{C_3}$$

$$= \frac{2}{4} : \frac{3}{6} : \frac{5}{9}$$

or, $\frac{1}{2} : \frac{1}{2} : \frac{5}{9}$

or, 9:9:10.

3. Three partners invested their capitals in a business. If the timing of their investments is in the ratio of $t_1{:}t_2{:}t_3$, and their profits are in the ratio of $P_1{:}P_2{:}P_3$, then the ratio of their capitals invested is $\frac{P_1}{t_1}:\frac{P_2}{t_2}:\frac{P_3}{t_3}$.

**Illustration 5:** Gupta, Singhal and Kansal starts a business. If the ratio of their periods of investments are 1:2:5 and their profits are in the ratio of 3:4:5, find the ratio of capitals of Gupta, Singhal and Kansal.

**Solution:** We have, $P_1{:}P_2{:}P_3 = 3{:}4{:}5$

and $t_1{:}t_2{:}t_3 = 1{:}2{:}5.$

$\therefore$ The required ratio $= \frac{P_1}{t_1}:\frac{P_2}{t_2}:\frac{P_3}{t_3}$

$= \frac{3}{1}:\frac{4}{2}:\frac{5}{5}$ or 3:2:1

Thus, Gupta, Singhal and Kansal invested their capitals in the ratio of 3:2:1.

## Exercise-I

**1.** Nikita and Nishita enters into a partnership by inves investing ₹50,000 and ₹40,000, respectively. They agreed to share profits in the ratio of their capitals. Find out the share of Nikita when profit of the business is ₹22500 after a year.

(a) ₹1,500 (b) ₹9,500
(c) ₹10,500 (d) None of these

**2.** Niki, Nisha and Anu formed a partnership with investments of ₹75,000, ₹60,000 and ₹40,000, respectively. After 3 years of operation, the partnership earned a net profit of ₹26,250. What was the share of Anu in the profit?

(a) ₹6,000 (b) ₹5,000
(c) ₹8,000 (d) None of these

**3.** Mahesh, Suresh and Ganesh entered into a partnership. partnership business. Mahesh invested ₹16,000 for 9 months. Suresh invested ₹12,000 for 6 months and Ganesh invested ₹8,000 for 12 months. At the end of a year, there was a profit of ₹26,000. Find out the share of Suresh in the profit.

(a) ₹8,000 (b) ₹7,500
(c) ₹6,000 (d) None of these

**4.** Sita and Gita enters into a partnership. Sita contributes ₹5,000 while Gita contributes ₹4,000. After 1 month, Gita withdraws $\frac{1}{4}$ part of her contribution and after 3 months Sita invests ₹2,000 more. When Gita withdraws her investment, at the same time, Rita joins them by investing ₹7,000. If at the end of 1 year there is a profit of ₹1,218, what will be share of Rita in the profit?

(a) ₹488.47 (b) ₹8,447.37
(c) ₹588.47 (d) None of these

**5.** A starts business with an investment of ₹3500. Five months later B joins A as a partner. After a year, the profits are divided in the ratio of 2:3. How much did B contribute?

(a) ₹7,000 (b) ₹11,000
(c) ₹9,000 (d) None of these

**6.** Gupta and Bansal enters into a partnership with their capitals in the ratio 5:6. At the end of 8 months, Gupta withdraws his capital. If they receive their shares profits in the ratio of 5:9, find out how long Bansal's capital was invested in the business?

(a) 10 months (b) 12 months
(c) 14 months (d) None of these

**7.** Arvind began a business with ₹550. Later, Brij with ₹330. When did Brij join if the profit at the end of the year was divided in the ratio 10:3?

(a) After 4 months (b) After 6 months
(c) After 4.5 months (d) None of these

**8.** A began a business with ₹3750. Later, with ₹5000. When did B join if the profits at the end of the year was divided equally?

(a) After 5 months (b) After 9 months
(c) After 7 months (d) None of these

**9.** Anju and Brijesh enters into a partnership with their capitals in the ratio of 5:9. At the end of 8 months, Anju withdraws her capital. If they receive their share of profit in the ratio of 4:9, find out how long Brijesh's capital was invested in the business.

(a) 8 months (b) 10 months
(c) 12 months (d) None of these

**10.** A, B and C invested capitals in the ratio 3:5:9; the timing of their investments being in the ratio 2:3:1. In what ratio would their profits be distrubuted?

(a) 2:5:3 (b) 3:2:5
(c) 7:5:3 (d) None of these

**11.** Sumit, Punit and Ramit started a business by investing their capitals in the ratio of 1:2:3. At the end of the business term, they received their shares of profit in the ratio of 1:2:3. Find out the ratio of time for which they invested their capitals.

(a) 1:1:1 (b) 2:3:4
(c) 2:4:3 (d) None of these

**12.** A, B and C starts a business. If the ratio of their periods of investments are 2:3:6 and their profits are in the ratio of 4:5:6, then the ratio of capitals of A, B and C is:

(a) 6:8:10 (b) 12:10:6
(c) 10:12:6 (d) None of these

**13.** A, B and C rented a pasture. A puts in 12 oxen for 6 months, B 8 oxen for 7 months and C 6 oxen for 8 months. If the rent of the field is ₹396, what amount of rent was paid by A?

(a) ₹126 (b) ₹108
(c) ₹162 (d) ₹168

**14.** A, B, C and D enters into partnership. A contributes $\frac{1}{3}$ of the capital, B contributes $\frac{1}{4}$, C contributes $\frac{1}{5}$ and D contributes the rest. What is the share of D when profit is ₹6000?

(a) ₹2000 (b) ₹1600
(c) ₹1200 (d) ₹1300

**15.** A and B enters into a partnership for a year. A contributes ₹1500 and B ₹2000. After 4 months, they admits C who contributes ₹2250. If B withdraws his contribution after 9 months, at the end of the year they share profit in the ratio:

(a) 2:1:3 (b) 1:3:2
(c) 1:1:2 (d) 1:1:1

**16.** A and B started a business with initial investments in the ratio of 5:7. If, after one year, their profits were in the ratio of 1:2 and the period for A's investment was for 7 months, B invested the money for:

(a) 6 months (b) $2\frac{1}{2}$ months
(c) 10 months (d) 4 months

**17.** A and B jointly invests ₹2100 and ₹3100 in a firm. A is an active partner, hence he receives 25% of the profit separately. If their business yields ₹1040 as profit, what will be the profit share for each of them?

(a) ₹415, ₹625 (b) ₹575, ₹465
(c) ₹515, ₹525 (d) ₹560, ₹480

**18.** Two partners invested ₹12500 and ₹8500 in a business, They decided that 60% of the profit incurred from the business will be equally divided between them while remaining profit will be assumed as interest on their capitals. If one of the partners receives ₹300 more profit than the other, what is the total profit in the business?

(a) ₹3937.50 (b) ₹4940.50
(c) ₹3936.50 (d) ₹4156

**19.** A, B, C enters into a partnership with shares in the ratio $\frac{7}{2}:\frac{4}{3}:\frac{6}{5}$. After 4 months, A increases his share by 50%. If the total profit at the end of one year be ₹21600, then B's share in the profit is:

(a) ₹2100 (b) ₹2400
(c) ₹3600 (d) ₹4000

**20.** A and B invests in a business in the ratio of 3:2. If 5% of the total profit goes to charity and A's share is ₹855, then total profit is:

(a) ₹1576 (b) ₹1537.50
(c) ₹1500 (d) ₹1425

**21.** In a business B a sleeping partner and A is a working partner. A invests ₹5000 and B invests 6000. A receives $12\frac{1}{2}$% of profit for managing the business and the remaining amount is divided in propoftion to their capitals. A's share of profit in a profit of ₹880 is:

(a) ₹350 (b) ₹400
(c) ₹420 (d) ₹460

**22.** A starts business with a capital of ₹1200. B and C join with some investments after 3 and 6 months, respectively. If, at the end of a year, the profit is divided in the ratio of 2:3:5, what is B's investment in the business?

(a) ₹2400 (b) ₹1800
(c) ₹3600 (d) ₹6000

**23.** A, B and C entered into a partnership with ₹35,12,420, ₹42,22,180 and ₹40,65,400. After 2 years, A withdrew ₹11 Lakhs. At the same time, C invested ₹8 Lakhs more. If at the end of 3 years, profit is ₹10,53,000, what is the share of C in the profit?

(a) ₹283,117.80 (b) ₹379,996.20
(c) ₹399,866 (d) ₹299,866
(e) None of these

**24.** A and B enters into a partnership. A supplies whole of the capital amounting to ₹45000 with the condition that the profits are to be equally distributed and that B pays A interest on half of the capital at 10% per annum, but receives, ₹120 per month for carrying on the concern. When B's income is 1/2 of A's income, their total yearly profit is:

(a) ₹9180 (b) ₹7150
(c) ₹3060 (d) ₹1440
(e) None of these

**25.** A, B and C entered into a partnership by investing ₹12000, ₹15000 and ₹18000, respectively. A is also a working partner and receiving 15% of the annual profit for his work. If B and C received ₹8500 and ₹10200 from the annual profit as their shares, what amount did A receive from the annual profit?

(a) ₹10,500 (b) ₹11,500
(c) ₹11,300 (d) ₹14,000

## Exercise-2
## (Based on Memory)

**1.** A began business with ₹45000 and was joined afterwards by B with ₹54000. After how many months, did B join if the profits at the end of the year were divided in the ratio 2:1?

(a) 4 (b) 5
(c) 6 (d) 7

**[SSC (GL) Prel. Examination, 2005]**

**2.** Ninad, Vikas and Manav enter into a partnership. Ninad invests some amount at the beginning. Vikas invests double the amount after 6 months and Manav invests thrice the amount invested by Ninad after 8 months. They earn a profit of ₹45000 at the end of the year. What is Manav's share in the profit?

(a) ₹25000 (b) ₹15000
(c) ₹12000 (d) ₹9000

**[SBI PO Examination, 2008]**

**3.** Arun started a business investing ₹38000. After 5 months Bakul joined him with a capital of ₹55000. At the end of the year the total profit was ₹22000. What is the approximate difference between the share of profits of Arun and Bakul?

(a) ₹1192 (b) ₹1856
(c) ₹1007 (d) ₹1928
(e) ₹1568

**[IDBI Bank Examination, 2007]**

**4.** Sarita started a business investing ₹50000. After six months, Abhishek joined her with ₹75000. After another six months Nisha also joined them with ₹1.25 lakh. Profit earned at the end of 2 yea₹from when Sarita started the business should be distributed among Sarita, Abhishek and Nisha in what respective ratio?

(a) 4:5:6 (b) 8:9:10
(c) 8:9:12 (d) 4:5:8
(e) None of these

**[PNB Mgt. Trainee Examination, 2007]**

**5.** Four milkmen rented a pasture. A grazed 15 cows for 4 months, B grazed 12 cows for 2 months, C grazed 18 cows for 6 months, and D grazed 16 cows for 5 months. If A's share of rent is ₹1020, what is C's share of rent?

(a) ₹1836 (b) ₹1360
(c) ₹816 (d) Cannot be determined

**[OBC PO Examination, 2007]**

**6.** Pankaj started a business investing ₹42000. After 4 months Nitin joined him with a capital of ₹57000. At the end of the year the total profit was ₹26000. What is the difference between the share of profits of Pankaj and Nitin?

(a) ₹1200 (b) ₹1400
(c) ₹1600 (d) ₹1800
(e) None of these

**[Corporation Bank PO Examination, 2007]**

**7.** A started a business with ₹10000 and B joined him later with a capital of ₹40000. If at the end of the year, they both get an equal share of the profit, how many months after the business started did B join it?

(a) 4 months (b) 6 months
(c) 8 months (d) 9 months

**[SI of Police Rec. Examination, 1997]**

**8.** A, B, C enter into a partnership investing ₹35000, ₹45000 and ₹55000 respectively. The respective shares of A, B, C in an annual profit of ₹40500 are:

(a) ₹13500, ₹16500, ₹10500
(b) ₹10500, ₹13500, ₹16500
(c) ₹13500, ₹10500, ₹16600
(d) None of these

**[SI of Police Rec. Examination, 1997]**

**9.** Three men rent a pasture for ₹660. The first uses it to graze 50 sheep for 4 months, the second uses it to graze 40 sheep for 3 months and the third 46 sheep for 5 months. How much should the first man pay as rent?

(a) ₹276 (b) ₹220
(c) ₹144 (d) ₹240

**[SI of Police Rec. Examination, 1997]**

**10.** A began business with ₹45000 and B joined afterwards with ₹30000. At the end of a year, the profit is divided in the ratio 2:1. When did B join?

(a) 3 months after
(b) 6 months after
(c) 8 months after
(d) 9 months after

**[Assistant's Grade Examination, 1997]**

**11.** A, B and C invested ₹10000, ₹14000 and ₹12000, respectively in a business. If at the end of a year, they got a profit of ₹5400, the share of B in profit (if profit is divided in proportion to the investment of each) is:

(a) ₹1500 (b) ₹2100
(c) ₹1800 (d) ₹150

**[Assistant's Grade Examination, 1998]**

**12.** A starts business with ₹3500 and after 5 months B joins with A as his partner. After a year, the profit is divided in the ratio 2:3. What is B's contribution in the capital?

(a) ₹8000 (b) ₹8500
(c) ₹9000 (d) ₹7500

**[SSC (GL) Prel. Examination, 2000]**

**13.** A, B and C rent a pasture. A puts 10 oxen for 7 months, B puts 12 oxen for 5 months and C puts 15 oxen for 3 months for grazing. If the rent of the pasture is ₹175, then how much C must pay as his share of rent?

(a) ₹45 (b) ₹50
(c) ₹55 (d) ₹60

**[SSC (GL) Prel. Examination, 2000]**

**14.** A, B and C enters into a partnership their shares are in the of ratio $\frac{1}{2}:\frac{1}{3}:\frac{1}{4}$. After 2 months, A withdraws half of his capital After 10 months, a profit of ₹378 is divided among them. What is B's share?

(a) ₹129 (b) ₹144
(c) ₹156 (d) ₹168

**[SSC (GL) Prel. Examination, 2000]**

**15.** A and B are partners in a business. A contrbutes $\frac{1}{4}$ of the capital for 15 months and B received $\frac{1}{4}$ of the profit. Find for how long B's money was invested in the business?

(a) 1 year (b) 9 months
(c) 6 months (d) 10 months

**[SSC (GL) Prel. Examination, 2000]**

**16.** A, B and C are partners of a company. During a particular year A received 1/3 of the profit, B received $\frac{1}{4}$ of the profit and C received the remaining ₹5000. How much did A receive?

(a) ₹5000 (b) ₹4000
(c) ₹3000 (d) ₹1000

**[SSC (GL) Prel. Examination, 2000]**

**17.** A began a business with ₹4500. Later, B joined A with ₹5400. When did B join if the profits at the end of the year were divided in the ratio of 2:1?

(a) 4 months (b) 5 months
(c) 6 months (d) 7 months

**[SSC (GL) Prel. Examination, 2000]**

**18.** Vinay started a business investing ₹70000. Ashok joined him after six months with an amount of ₹105000. Sunil joined them with ₹1.4 Lakh after another six months. The amount of profit earned should be distributed in what ratio among Vinay, Ashok and Sunil, three years after Vinay started the business?

(a) 42:45:56 (b) 7:6:10
(c) 12:15:16 (d) Cannot be determined
(e) None of these

**[PNB Management Trainee Examination, 2003]**

**19.** Veena started a business, investing ₹75000. After 3 months, Poonam joined her with an amount of ₹125000 and after another six months Sarita joined them with an amount of ₹150000. Profit earned at the end of three years from when Veena started the business shoud be distributed in what ratio among Veena, Poonam and Sarita, respectively?

(a) 36:55:54 (b) 18:28:27
(c) 35:54:55 (d) Cannot be determined
(e) None of these

**[Bank of Maharashtra PO Examination, 2003]**

**20.** Three friends X, Y and Z started a partnership for a period of 3 years by contributing capitals in the ratio of 5:4:2. What is the amount received by X as his share in the total profit?

I. Total amount invested in the business is ₹22000.

II. Profit was distributed after a period of 2 years.

III. The average amount of profit earned per year is ₹2750.

(a) I only (b) II only
(c) III only (d) I or III only

**[SBI PO Examination, 1999]**

**21.** Three friends A, B and C started a business by investing capitals in the ratios 5:7:6. After 6 months, C withdraws half of his capital. If the sum invested by A is ₹40000, out of the total annual profit of ₹33000. *C*'s share will be:

(a) ₹9000 (b) ₹12000
(c) ₹11000 (d) ₹10000

**[BSRB Hyderabad PO Examination, 1999]**

**22.** Mr Saxena started a business investing ₹5000. Four months later, Mr Jain joined the business by investing ₹9000. If the profit at the end of the year was ₹22000, then how much amount would Mr Jain have received as the profit?

(a) ₹16000 (b) ₹14000
(c) ₹12000 (d) ₹11000

**[BSRB Delhi PO Examination, 2000]**

**23.** Vinod and Ankit started a business by investing capitals in the ratio of 2:3. If Vinod had invested an additional amount of ₹10000, the ratio of Vinod's investment to Ankit's investment would have been 3:2. What was the amount invested by Vinod?

(a) ₹8000 (b) ₹12000
(c) ₹9000 (d) Data inadequate

**[BSRB Patna PO Examination, 2001]**

**24.** Vinay started a business investing ₹50000. After 1 year, he invested another ₹30000 and Aditya also joined him with a capital of ₹70000. If the profit earned in 3 years from the starting of business was ₹87500, find out the share of Aditya in the profit.

(a) ₹37500 (b) ₹32500
(c) ₹38281 (d) None of these

**[Corporation Bank PO Examination, 2002]**

**25.** A started a business with ₹10000. B joined him later with a capital of ₹40000. If at the end of the year, they both received equal shares of the profit. How many months after the business started did B join it?

(a) 4 months (b) 6 months
(c) 8 months (d) 9 months

**[SI of Police Rec. Examination, 1997]**

**26.** A, B, C enters into a partnership investing ₹35000, ₹45000 and ₹55000. The respective shares of A, B, C in an annual profit of ₹40500 are:

(a) ₹13500, ₹16500, ₹10500
(b) ₹10500, ₹13500, ₹16500
(c) ₹13500, ₹10500, ₹16600
(d) None of these

**[SI of Police Rec. Examination, 1997]**

**27.** Three men rent a pasture for ₹660. The first uses it to graze 50 sheeps for 4 months. The second uses it to graze 40 sheeps for 3 months. The third uses it to graze 46 sheep for 5 months. How much should the first man pays as rent?

(a) ₹276 (b) ₹220
(c) ₹144 (d) ₹240

**[SI of Police Rec. Examination, 1997]**

**28.** A began a business with ₹45000. Later, B joined him with ₹30000. At the end of the year, the profit was divided in the ratio of 2:1. When did B join?

(a) 3 months after (b) 6 months after
(c) 8 months after (d) 9 months after

**[Assistant's Grade Examination, 1997]**

**29.** A, B and C invested ₹10000, ₹14000 and ₹12000 in a business. If at the end of a the business earns a profit of ₹5400, the share of B in profit (if profit is divided in proportion to the partner's investments) is:

(a) ₹1500 (b) ₹2100
(c) ₹1800 (d) ₹150

**[Assistant's Grade Examination, 1998]**

**30.** A starts business with ₹3500. 5 months later B joins A as his partner. After a year, the profit is divided in the ratio of 2:3. What is B's contribution in the capital?

(a) ₹8000 (b) ₹8500
(c) ₹9000 (d) ₹7500

**[SSC (GL) Prel. Examination, 2000]**

**31.** Average score of Rahul, Manish and Suresh is 63. Rahul's score is 15 less than Ajay and 10 more than Manish. If Ajay scored 30 marks more than the average scores of Rahul, Manish and Suresh, what is the sum of Manish's and Suresh's scores?

(a) 120 (b) 111
(c) 117 (d) Cannot be determined

**[Corporation Bank PO Examination, 2011]**

**32.** A and B enter into partnership with capitals in the ratio 5:6. At the end of 8 months A withdraws his capital. They received profits in the ratio 5:9. B invested the capital for:

(a) 6 months (b) 8 months
(c) 10 months (d) 12 months

**[SSC, 2010]**

**33.** A, B and C started a business investing ₹42000, ₹30000 and ₹28000, respectively. After 4 months, A withdrew ₹12000, B withdrew ₹6000 and C withdrew ₹8000. If, after 10 months, a total profit of ₹46420 is earned, what is the share of C?

(a) ₹12580 (b) ₹13160
(c) ₹13020 (d) ₹12540
(e) ₹12760

**[IBPS PO/MT, 2014]**

**34.** Three men A, B and C starts a business together. They invests ₹30000, ₹24000 and ₹42000, respectively, at the beginning. After 4 months, B withdrew ₹6000 and C withdrew ₹10000. They received a profit of ₹11960 at the end of the year. B's share in the profit is:

(a) ₹2700 (b) ₹2803
(c) ₹2900 (d) ₹2785
(e) None of these

**[IBPS PO/MT, 2013]**

**35.** An amount of money is to be divided among P, Q and R in the ratio of 3:5:7, respectively. If the amount received by R is ₹4,000 more than the amount received by Q, what will be the total amount received by P and Q together?

(a) ₹8,000 (b) ₹12,000
(c) ₹16,000 (d) Cannot be determined
(e) None of these

**[Allahabad Bank PO, 2010]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (d) | **2.** (a) | **3.** (c) | **4.** (a) | **5.** (c) | **6.** (b) | **7.** (b) | **8.** (b) | **9.** (b) | **10.** (a) | **11.** (a) | **12.** (b) | **13.** (c) |
| **14.** (d) | **15.** (d) | **16.** (c) | **17.** (b) | **18.** (a) | **19.** (d) | **20.** (c) | **21.** (d) | **22.** (a) | **23.** (e) | **24.** (a) | **25.** (c) | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (d) | **2.** (b) | **3.** (b) | **4.** (b) | **5.** (a) | **6.** (e) | **7.** (a) | **8.** (b) | **9.** (d) | **10.** (d) | **11.** (b) | **12.** (c) | **13.** (a) |
| **14.** (b) | **15.** (d) | **16.** (b) | **17.** (d) | **18.** (c) | **19.** (a) | **20.** (c) | **21.** (a) | **22.** (c) | **23.** (a) | **24.** (d) | **25.** (d) | **26.** (b) |
| **27.** (d) | **28.** (d) | **29.** (b) | **30.** (c) | **31.** (b) | **32.** (d) | **33.** (e) | **34.** (b) | **35.** (c) | | | | |

# EXPLANATORY ANSWERS

## Exercise-1

**1.** **(d)** Here, $C_1 = 50000$, $C_2 = 40000$ and $P = 22500$.

$\therefore C_1 + C_2 = 50000 + 40000 = 90000.$

$$\therefore \text{Nikita's share} = \frac{C_1 \times P}{C_1 + C_2} = \frac{50000 \times 22500}{90000}$$

$$= \frac{5}{9} \times 22500 = ₹12500.$$

**2.** **(a)** Ratio of the capitals

$= 75000{:}60000{:}40000 = 15{:}12{:}8$

$\therefore$ Profit-sharing ratio = 15:12:8

Sum of the profit-sharing ratio = 15 + 12 + 8 = 35

Total profit = ₹26250

$$\therefore \text{Anu's share} = \frac{8}{35} \times 26250$$

$= ₹6000$

**3.** **(c)** Here, $C_1 = 16000$, $C_2 = 12000$, $C_3 = 8000$, $t_1 = 9$, $t_2 = 6$, $t_3 = 12$ and $P = 26000$.

Suresh's share in the profit

$$= \frac{C_2 \times t_2 \times P}{C_1t_1 + C_2t_2 + C_3t_3}$$

$$= \frac{12000 \times 6 \times 26000}{16000 \times 9 + 12000 \times 6 + 8000 \times 12} = \frac{1872000000}{312000}$$

$= ₹6000$

**4.** **(a)** Here,

$C_1 \times t_1 = 5000 \times 12 + 2000 \times 9 = 78000,$

$C_2 \times t_2 = 4000 \times 1 + 3000 \times 11 = 37000,$

$C_3 \times t_3 = 7000 \times 11 = 77000$ and $P = 1218.$

$\therefore$ Rita's share in the profit

$$= \frac{C_3 \times t_3 \times P}{C_1t_1 + C_2t_2 + C_3t_3}$$

$$= \frac{77000 \times 1218}{78000 + 37000 + 77000} = ₹488.47.$$

**5.** **(c)** We have, $C_1 \times t_1 = 3500 \times 12 = 42000$ and $C_2 \times t_2 = x \times 7 = 7x.$

Then, $\frac{\text{Profit for A}}{\text{Profit for B}} = \frac{C_1 \times t_1}{C_2 \times t_2}$

$\Rightarrow \frac{2}{3} = \frac{42000}{7x}$ or $x = \frac{42000 \times 3}{2 \times 7} = ₹9000.$

**6.** **(b)** Let, Bansal's capital be invested for $x$ months.

Then, we have $\frac{5 \times 8}{6 \times x} = \frac{5}{9}$

$\Rightarrow x = \frac{5 \times 8 \times 9}{6 \times 5} = 1$ month.

$\therefore$ Bansal's capital was invested for 12 months.

**7.** **(b)** Let, Brij remain in the business for $x$ months.

We have, $C_1 \times t_1 = 550 \times 12 = 6600$

$C_2 \times t_2 = 330 \times x = 330x$

$\therefore \frac{\text{Arvind's share of profit}}{\text{Brij's share of profit}} = \frac{C_1 \times t_1}{C_2 \times t_2}$

$\Rightarrow \frac{10}{3} = \frac{6600}{330x} \Rightarrow x = \frac{6600 \times 3}{330 \times 10} = 6$ months.

**8.** **(b)** Let, $B$ remain in the business for $x$ months.

We have, $C_1 \times t_1 = 3750 \times 12 = 45000$

and $C_2 \times t_2 = 5000 \times x = 5000x$

$\therefore \frac{\text{A's share in profit}}{\text{B's share in profit}} = \frac{C_1 \times t_1}{C_2 \times t_2}$

$\Rightarrow \frac{1}{1} = \frac{45000}{5000x}$

or, $x = \frac{45000}{5000} = 9$ months

**9.** **(b)** Let, Brijesh's capital be invested for $x$ months.

Capital ratio of Anju and Brijesh is 5:9.

Let the capitals of Anju and Brijesh be ₹$5y$ and ₹$9y$.

We have, $C_1 \times t_1 = 5y \times 8 = 40y$

and, $C_2 \times t_2 = 9y \times x = 9yx$

$\therefore \frac{\text{Anju's share of profit}}{\text{Brijesh's share of profit}} = \frac{C_1 \times t_1}{C_2 \times t_2}$

$\Rightarrow \frac{4}{9} = \frac{40y}{9yx} \Rightarrow x = \frac{40 \times 9}{4 \times 9} = 10$ months.

**10.** **(a)** Ratio of capitals of A, B and C is 3:5:9. Let the capitals of A, B and C be $3x$, $5x$ and $9x$, respectively.

Ratio of timing of their investments are 2:3:1. Let, A, B and C invest their capitals for $2y$, $3y$ and $y$ months, respectively.

Then, profit of A : profit of B : profit of C

$= C_1 \times t_1 : C_2 \times t_2 : C_3 \times t_3$

$= 3x \times 2y : 5x \times 3y : 9x \times y$

$= 6:15:9$ or $2:5:3.$

**11.** **(a)** We have, $C_1:C_2:C_3 = 1:2:3$

and $P_1:P_2:P_3 = 1:2:3.$

$\therefore$ Required ratio $= \frac{P_1}{C_1} : \frac{P_2}{C_2} : \frac{P_3}{C_3} = \frac{1}{1} : \frac{2}{2} : \frac{3}{3}$

or, 1:1:1.

Thus, Sumit, Punit and Ramit invested their capitals for equal period of time.

**12.** **(b)** We have, $P_1:P_2:P_3 = 4:5:6$ and $t_1:t_2:t_3 = 2:3:6.$

$\therefore$ Required ratio $= \frac{P_1}{t_1} : \frac{P_2}{t_2} : \frac{P_3}{t_3} = \frac{4}{2} : \frac{5}{3} : \frac{6}{6}$

or, 12:10:6.

Thus, $A$, $B$ and $C$ invested their capitals in the ratio of 12:10:6.

**13.** **(c)** Ratio in which A, B, C pays the rent

$= (6 \times 12):(8 \times 7):(6 \times 8)$

$= 72:56:48$

$= 9:7:6$

Rent paid by A $= \frac{9}{22} \times ₹396 = ₹162.$

**14.** **(d)** D's capital $= 1 - \frac{1}{3} - \frac{1}{4} - \frac{1}{5} = \frac{13}{60}$

Profit ratio of A, B, C, D $= \frac{1}{3} : \frac{1}{4} : \frac{1}{5} : \frac{13}{60}$

$\Rightarrow$ 20:15:12:13

$\therefore$ Share of D $= \frac{13}{60} \times ₹6000 = ₹1300.$

**15.** **(d)** Obviously, C invests for $12 - 4 = 8$ months.

$\therefore$ Equivalent capitals are

₹1500 × 1; ₹2000 × $\frac{9}{12}$ = ₹1500,

₹2250 × $\frac{8}{12}$ = ₹1500

$\therefore$ Profit is to be shared in the ratio of 1500:1500:1500 = 1:1:1.

**16.** **(c)** Let, investments of A and B be $5x$ and $7x$. The period of B's investment be for $y$ months

Then, $\frac{(5x) \times 7}{(7x) \times y} = \frac{1}{2} \Rightarrow y = 10.$

**17.** **(b)** Total profit in a business = ₹1040

Separate profit for A = 25% of ₹1040

$= \frac{1040 \times 25}{100} = ₹260$

Remaining profit = ₹(1040 – 260) = ₹780

The remaining profit will be divided in proportion to their capitals.

$\therefore$ Ratio between capitals of A and B = 2100:3100 = 21:31

Sum of Editor : proportional? capital? = 21 + 31 = 52

$\therefore$ A's profit = $\frac{21}{52} \times 780$ = ₹315

B's profit = $\frac{31}{52} \times 780$ = ₹465

Total profit of A = ₹(315 + 260) = ₹575

Therefore, A and B's profit shares will be ₹575 and ₹465.

**18.** **(a)** Suppose, total profit in the business = ₹$x$

$\therefore$ 60% of total profit = 60% of $x$ = ₹ $\frac{3x}{5}$

$\therefore$ The two partners will receive profit of ₹ $\frac{3x}{10}$ and ₹ $\frac{3x}{10}$, respectively.

$\therefore$ Remaining profit = $x - \frac{3x}{5}$ = ₹ $\frac{2x}{5}$.

The remaining profit assumed as interest on the capital will be divided in the proportion of their capitals.

Their capital ratio = 12500:8500 = 25 : 17

Sum of proportionals = 25 + 17 = 42

$\therefore$ The first partner's profit = $\frac{25}{42} \times \frac{2x}{5}$ = ₹ $\frac{5x}{21}$

The second partner's profit = $\frac{17}{42} \times \frac{2x}{5}$ = ₹ $\frac{17x}{105}$

Given $\frac{3x}{10} + \frac{5x}{21} = \frac{3x}{10} + \frac{17x}{105} + 300$

$\therefore \quad \frac{8x}{105} = 300$

or, $\quad x = \frac{105 \times 300}{8}$ = ₹3937.50

$\therefore$ Total profit in the business = ₹3937.50.

**19.** **(d)** The given ratio = $\frac{7}{2} : \frac{4}{3} : \frac{6}{5}$ = 105:40:36

Let they initially invest ₹105, ₹40 and ₹36, respectively.

Ratio of investments

= [105 × 4 + (150% of 105) × 8]:(40 × 12):(36 × 12)

= 1680:480:432 = 35:10:9

$B$'s share = ₹$\left(21600 \times \frac{10}{54}\right)$ = ₹4000.

**20.** **(c)** Let the total profit be ₹100.

After paying the charity, A's share = ₹$\left(95 \times \frac{3}{5}\right)$

= ₹57

If A's share is ₹57, total profit = ₹100

If A's share is ₹855, total profit = ₹$\left(855 \times \frac{100}{57}\right)$

= ₹1500.

**21.** **(d)** A's share for managing the business

= $12\frac{1}{2}\%$ of ₹880 = ₹110

Remaining profit = ₹770

Profit ratio of A and B = 5:6

A's share = $\frac{5}{11}$ of ₹770 = ₹350

A's total profit = ₹350 + ₹110 = ₹460.

**22.** **(a)** Profit ratio of A, B and C is

(1200 × 12):($x$ × 9):($y$ × 6) = 2:3:5

$\Rightarrow \quad \frac{1200 \times 12}{2} = \frac{9x}{3}$

$\therefore \quad x$ = ₹2400.

**23.** **(e)** Share of $C$ in profit = $\frac{C_3t_3 \times P}{C_1t_1 + C_2t_2 + C_3t_3}$

[Here, $C_1 \times t_1$ = 3512420 × 2 + 2412420 × 1

$C_2 \times t_2$ = 4222180 × 3'$C_3 \times t_3$

= 4065400 × 2 + 4865400 × 1 and $P$ = 105300]

$$= \frac{(4065400 \times 2 + 4865400 \times 1) \times 1053000}{(3512420 \times 2 + 2412420 \times 1) + 4222180 \times 3 + (4065400 \times 2 + 4865400 \times 1)}$$

= ₹389886.

**24.** **(a)** Let the total profit be ₹$x$

Salary given to B = ₹1440

$\therefore$ Net profit = $x$ − 1440

$\therefore$ Share of A and B each = $\frac{x - 1440}{2}$

Interest given by B to A = $\frac{10}{100} \times 22500$ = ₹2250.

$$\therefore \quad \frac{\frac{x-1440}{2} + 1440 - 2250}{\frac{x-1440}{2} + 2250} = \frac{1}{2}$$

or, $\quad \frac{x - 3060}{x + 3060} = \frac{1}{2}$

$\therefore \quad x$ = ₹9180.

**25.** **(c)** Capital ratio of A, B, C is 12000:15000:18000 = 4:5:6

Profit ratio of B and C = 8500:10200 = 5:6

$\therefore$ A's share of profit = $\frac{4}{5} \times$ Rs. 8500 = ₹6800

85% of $x$ = 6800 + 8500 + 10200

= 25500

$\therefore$ 15% of $x$ = $\frac{25500 \times 15}{85}$ = 4500

Total profit of A = ₹6800 + ₹4500 = ₹11300.

# Exercise-2
## (Based on Memory)

1. **(d)** Suppose B joined after $x$ months

$$\therefore \quad \frac{45000 \times 12}{54000 \times (12 - x)} = \frac{2}{1}$$

$\Rightarrow$ 45000 × 12

= 54000 × 12 × 2 – 54000 × 2 × $x$

$\Rightarrow$ $108x = 54 \times 24 - 45 \times 12$

$\Rightarrow$ $27x = 54 \times 6 - 45 \times 3$

$\Rightarrow$ $27x = 324 - 135 = 189 \Rightarrow x = 7$

$\therefore$ B joined after 7 months.

2. **(b)** Let the investment of Ninad be ₹$x$

$\therefore$ Investment of Vikas = ₹$2x$

and investment of Manav = ₹$3x$

$\therefore$ Ratio of their investments

= $x \times 12 : 2x \times 6 : 3x \times 4$

= $12x : 12x : 12x = 1:1:1$

$\therefore$ Manav's share in the profit

$= \frac{1}{3} \times 45000 =$ ₹15000

3. **(b)** Ratio of investment is: Arun:Bakul

= 38000 × 12:55000 × 7 = 38 × 12:55 × 7

= 456:385 ≈ 45:38

Required difference $= \frac{22000}{45+38} \times (45-38)$

$= \frac{22000 \times 7}{83} \approx \frac{22000}{12} \approx 1835 \approx$ ₹1856

4. **(b)** Sarita:Abhihek:Nisha

= 50000 × 24:75000 × 18:125000 × 12

= 2 × 24:3 × 18:5 × 12

= 2 × 4:3 × 3:5 × 2 = 8:9:10

5. **(a)** 15 × 4 = ₹1020

$\therefore \quad 18 \times 6 \equiv \frac{1020}{15 \times 4}(18 \times 6) =$ ₹1836

6. **(e)** Ratio of their shares = 42 × 12:57 × 8

= 14 × 12:19 × 8 = 21:19

Required difference in shares

$= \frac{26000}{21+19} \times (21-19) =$ ₹1300

7. **(d)** Suppose, B joins A after K months.

$\therefore$ Investments of A and B are in the ratio of

10000 × 12:40000 × (12 – $K$)

$\therefore$ 10000 × 12 = 40000 × (12 – $K$)

i.e., $4(12 - K) = 12 \Rightarrow K = 9$.

8. **(b)** A, B, C invest in the ratio

35000:45000:55000 i.e., 7:9:11

$\therefore$ A's share in the profit $= \frac{7}{27} \times 40500$

= 7 × 1500 = ₹10500

B's share in the profit = 9 × 1500 = ₹13500

C's share in the profit = 11 × 1500 = ₹16500.

9. **(d)** They pay in the ratio 50 × 4:40 × 3:46 × 5

i.e., 200:120:230

i.e., 20:12:23

$\therefore$ 1st man should pay ₹$\frac{20}{55} \times 660$ = ₹240.

10. **(d)** Suppose B joined after $K$ months

$\therefore$ Profit is divided in the ratio of

45000 × 12:30000 × $K$

$\therefore \quad \frac{45000 \times 12}{30000 \times K} = \frac{2}{1} \Rightarrow 60000K = 540000$

$\therefore$ $K = 9$.

11. **(b)** Profit is divided between A, B and C in the ratio 10:14:12

i.e., 5:7:6

$\therefore$ B's share $= \frac{7}{18} \times 5400$ = ₹2100.

12. **(c)** Let B's contribution be ₹$x$

$$\therefore \quad \frac{3500 \times 12}{7x} = \frac{2}{3}$$

or, $x = \frac{3500 \times 12 \times 3}{7 \times 2}$ $\quad \therefore \quad x = 9000$.

13. **(a)** A, B and C pay in the ratio of

10 × 7:12 × 5:15 × 3

i.e., 70:60:45

i.e., 14:12:9

$\therefore$ C pay ₹$\frac{9}{35}$ × 175 = ₹45.

14. **(b)** Suppose, shares of A, B and C are $6K$, $4K$ and $3K$, respectively.

$\therefore$ Profit of 378 is divided among them in the ratio of $6K \times 2 + 3K \times 10 : 4K \times 12 : 3K \times 12$

i.e., 42:48:36

i.e., 7:8:6

$\therefore$ B's share $= \frac{8}{21} \times 378$ = ₹144.

**15.** **(d)** A's capital $= \frac{1}{4}K$

B's capital $= \frac{3}{4}K$

A and B share the total profit in the ratio 1:2. Let B contribute for $x$ months

$$\therefore \quad \frac{\frac{1}{4}K \times 15}{\frac{3}{4}K \times x} = \frac{1}{2} \Rightarrow x = 10.$$

**16.** **(b)** Profit earned by

$$C = 1-\left(\frac{1}{3}+\frac{1}{4}\right) = 1-\frac{7}{12} = \frac{5}{12}$$

So, $\frac{5}{12} = 5000 \qquad \therefore \quad 1 \rightarrow 12000$

$\therefore$ Profit received by $A = \frac{1}{3} \times 12000 =$ ₹4000.

**17.** **(d)** Suppose, B joined after $K$ months

$\therefore$ 4500 × 12:5400 × (12 – $K$) = 2:1

$$\Rightarrow \quad \frac{4500 \times 12}{5400 \times (12-K)} = \frac{2}{1}$$

$$\Rightarrow \quad \frac{60}{6(12-K)} = \frac{2}{1}$$

$\Rightarrow$ 12(12 – $K$) = 60 $\Rightarrow$ $K$ = 7.

**18.** **(c)** Ratio of their investments

= 70 × 36:105 × 30:140 × 24

= 12:15:16.

**19.** **(a)** Ratio of their profits

= 75 × 36:125 × 33:150 × 27

= 3 × 36:5 × 33:6 × 27

= 3 × 12:5 × 11:6 × 9

= 36:55:54.

**20.** **(c)** When investment ratio is given, the amount of profit can be found out with the help of III only.

**21.** **(a)** Sum invested by A, B and C is

5 × 12:7 × 12:6 × 6 + 3 × 6

or, 60:84:54

or, 10:14:9

$\therefore$ Share of C $= \frac{9}{33} \times 33000 =$ ₹9000.

**22.** **(c)** Ratio of their investments

= 50000 × 12:90000 × 8 = 5:6

$\therefore$ Amount received by Mr Jain

$= \frac{6}{11} \times 22000 =$ ₹12000.

**23.** **(a)** Let the initial investments of Vinod and Ankit be $2x$ and $3x$, respectively.

As per the question,

$$\frac{2 \qquad 10000}{} = \frac{3}{2}$$

or, $4x + 20000 = 9x$

$\therefore \quad x = 4000$

$\therefore$ Amount invested by Vinod

$= 2x =$ ₹8000.

**24.** **(d)** Ratio of Vinay and Aditya for one month

= (50000 × 12) + (80000 × 24):(70000 × 24)

= 60000 + 1920000:1680000 = 3:2

Hence, share of Aditya in the profit earned from the business $= \frac{87,500}{3+2} \times 2 =$ ₹35000.

**25.** **(d)** Suppose, B joins A after K months.

$\therefore$ Investments of A and B are in the ratio of

10000 × 12:40000 × (12 − $K$)

$\therefore$ 10000 × 12 = 40000 × (12 − $K$)

That is, 4 (12 − $K$) = 12 $\Rightarrow$ $K$ = 9.

**26.** **(b)** A, B, C invest in the ratio 35000:45000:55000

That is, 7:9:11

$\therefore$ A's share in the profit $= \frac{7}{27} \times 40500$

= 7 × 1500 = ₹10500

B's share in the profit = 9 × 1500 = ₹13500

C's share in the profit = 11 × 1500 = ₹16500.

**27.** **(d)** They pays in the ratio of 50 × 4:40 × 3:46 × 5

That is, 200:120:230

That is, 20:12:23

$\therefore$ The first man should pay ₹$\frac{20}{55} \times 660 =$ ₹240.

**28.** **(d)** Suppose, B joined after K months

$\therefore$ Profit is divided in the ratio of

45000 × 12:30000 × $K$

$$\therefore \quad \frac{45000 \times 12}{30000 \times K} = \frac{2}{1}$$

$\Rightarrow$ 60000 $K$ = 540000

$\therefore$ $K$ = 9.

**29.** **(b)** Profit is divided among A, B and C in the ratio of 10:14:12.

That is, 5:7:6

$\therefore$ B's share $= \frac{7}{18} \times 5400 =$ ₹2100.

**30.** **(c)** Let, B's contribution be ₹$x$

$$\therefore \quad \frac{3500 \times 12}{7x} = \frac{2}{3}$$

or, $$x = \frac{3500 \times 12 \times 3}{7 \times 2}$$

$\therefore$ $x$ = 9000.

**31.** **(b)** Let the score of Ajay $= x$

$$\text{Rahul} = x - 15$$

$$\text{Manish} = x - 25$$

As per the question, $x = 63 + 30$

$\therefore$ $x = 93$

$\therefore$ Score of Ajay $= 93$

then, Rahul $= 93 - 15 = 78$

then, Manish $= 93 - 25 = 68$

Total marks of Rahul, Manish and Suresh

$= 3 \times 63 = 189$

$\therefore$ Suresh $= 189 - (78 + 68) = 43$

$\therefore$ Manish + Suresh $= 68 + 43 = 111$

**32.** **(d)** Let A's amount be $5x$

B's amount be $6x$

Again, let B invested the capital for $y$ months

Now, according to the question,

$$\frac{5x \times 8}{6x \times y} = \frac{5}{9}$$

$$\Rightarrow \quad \frac{40}{6y} = \frac{5}{9}$$

$$\therefore \quad y = \frac{9 \times 40}{6 \times 5} = 12 \text{ months}$$

**33.** **(e)** Ratio of profits among A, B and C

$= (42000 \times 4 + 30000 \times 6):(30000 \times 4 + 24000 \times 6):(28000 \times 4 + 20000 \times 6)$

$= (168000 + 180000):(120000 + 144000):(112000 + 120000)$

$= 348000:264000:232000$

$= 348:264:232$

Hence, C's share $= \dfrac{46420}{844} \times 232 = ₹12760$

**34.** **(b)** Ratio of capital

$= (30000 \times 12):(24000 \times 4 + 18000 \times 8) : (42000 \times 4 + 32000 \times 8)$

$= 36000:(96000 + 144000):(168000 + 256000)$

$= 360000:240000:424000$

$= 360:240:424 = 45:30:53$

Sum of ratios $= 45 + 30 + 53 = 128$

Now, B' share $= \dfrac{30}{128} \times 11960 = ₹2803.125 \approx ₹2803$

**35.** **(c)** Difference of amount received by $R$ and $Q$ is $(7 - 5) = 2$, Total amount received by $P$ and $Q = (3 + 5) = 8$. Then, 2 corresponds to ₹4000 implies that 8 corresponds to $\dfrac{4000}{2} \times 8 = ₹16000$.

# Profit and Loss

# 9

## INTRODUCTION

Nowadays, transactions have become a common feature of life. When a person deals in the purchase and sale of any item, he either gains or loses some amount generally. The aim of any business is to earn profit. The commonly used terms in dealing with questions involving sale and purchase are:

**Cost Price:** The cost price of an article is the price at which an article has been purchased. It is abbreviated as C.P.

**Selling Price:** The selling price of an article is the price at which an article has been sold. It is abbreviated as S.P.

**Profit or Gain:** If the selling price of an article is more than the cost price, there is a gain or profit.

Thus, Profit or Gain = S.P. − C.P.

**Loss:** If the cost price of an article is greater than the selling price, the seller suffers a loss.

Thus, Loss = C.P. − S.P.

Note that profit and loss are always calculated with respect to the cost price of the item.

**Illustration 1:** (i) If C.P. = ₹235, S.P. = ₹240, then profit = ?

(ii) If C.P. = ₹116, S.P. = ₹107, then loss = ?

**Solution:** (i) Profit = S.P. − C.P. = 240 − 235 = ₹5.

(ii) Loss = C.P. − S.P. = 116 − 107 = ₹9.

## SOME BASIC FORMULAE

1. Gain on ₹100 is *Gain per cent*

$$\text{Gain \%} = \frac{\text{Gain} \times 100}{\text{C.P.}}$$

Loss on ₹100 is *Loss per cent*

$$\text{Loss \%} = \frac{\text{Loss} \times 100}{\text{C.P.}}$$

**Illustration 2:** The cost price of a shirt is ₹200 and selling price is ₹250. Calculate the % of profit.

**Solution:** We have, C.P. = ₹200, S.P. = ₹250.

Profit = S.P. − C.P. = 250 − 200 = ₹50.

$$\therefore \quad \text{Profit \%} = \frac{\text{Profit} \times 100}{\text{C.P.}} = \frac{50 \times 100}{200} = 25\%$$

**Illustration 3:** Anu bought a necklace for ₹750 and sold it for ₹675. Find her percentage of loss.

**Solution:** Here, C.P. = ₹750, S.P. = ₹675.

Loss = C.P. − S.P. = 750 − 675 = ₹75.

$$\therefore \quad \text{Loss \%} = \frac{\text{Loss} \times 100}{\text{C.P.}} = \frac{75 \times 100}{750} = 10\%$$

2. When the selling price and gain % are given:

$$\text{C.P.} = \left(\frac{100}{100 + \text{Gain\%}}\right) \times \text{S.P.}$$

3. When the cost and gain per cent are given:

$$\text{S.P.} = \left(\frac{100 + \text{Gain\%}}{100}\right) \times \text{C.P.}$$

**Explanation**

$$\text{Since Profit \%} = \frac{\text{Profit} \times 100}{\text{C.P.}}$$

$$= \left[\frac{(\text{S.P.} - \text{C.P.}) \times 100}{\text{C.P.}}\right]$$

$$\therefore \quad \frac{\text{Profit \%}}{100} = \frac{\text{S.P.}}{\text{C.P.}} - 1$$

$$\text{or,} \quad \frac{\text{S.P.}}{\text{C.P.}} = 1 + \frac{\text{Profit \%}}{100}$$

$$\therefore \quad \text{S.P.} = \left(\frac{100 + \text{Profit }\%}{100}\right) \times \text{C.P.}$$

$$\text{and, C.P.} = \left(\frac{100}{100 + \text{Profit }\%}\right) \times \text{S.P.}$$

4. When the cost and loss per cent are given:

$$\text{S.P.} = \left(\frac{100 - \text{Loss }\%}{100}\right) \times \text{C.P.}$$

5. When the selling price and loss per cent are given:

$$\text{C.P.} = \left(\frac{100}{100 - \text{Loss }\%}\right) \times \text{S.P.}$$

**Explanation**

$$\text{Since Loss }\% = \frac{\text{Loss} \times 100}{\text{C.P.}}$$

$$= \left[\frac{(\text{C.P.} - \text{S.P.}) \times 100}{\text{C.P.}}\right]$$

$$\therefore \quad \frac{\text{Loss}\%}{100} = 1 - \frac{\text{S.P.}}{\text{C.P.}}$$

$$\text{or} \quad \frac{\text{S.P.}}{\text{C.P.}} = 1 - \frac{\text{Loss}\%}{100}$$

$$\therefore \quad \text{S.P.} = \left(\frac{100 - \text{Loss}\%}{100}\right) \times \text{C.P.}$$

$$\text{and,} \quad \text{C.P.} = \left(\frac{100}{100 - \text{Loss}\%}\right) \times \text{S.P.}$$

**Illustration 4:** Mr Sharma buys a cooler for ₹4500. For how much should he sell it to gain 8%?

**Solution:** We have, C.P. = ₹4500, gain % = 8%

$$\therefore \quad \text{S.P.} = \left(\frac{100 + \text{Gain }\%}{100}\right) \times \text{C.P.}$$

$$= \left(\frac{100 + 8}{100}\right) \times 4500$$

$$= \frac{108}{100} \times 4500 = ₹4860.$$

**Illustration 5:** By selling a fridge for ₹7200, Pankaj loses 10%. Find the cost price of the fridge.

**Solution:** We have, S.P. = ₹7200, loss % = 10%

$$\therefore \quad \text{C.P.} = \left(\frac{100}{100 - \text{Loss}\%}\right) \times \text{S.P.}$$

$$= \left(\frac{100}{100 - 10}\right) \times 7200$$

$$= \frac{100}{90} \times 7200 = ₹8000.$$

**Illustration 6:** By selling a pen for ₹99, Mohan gains $12\frac{1}{2}$%. Find out cost price of the pen.

**Solution:** Here, S.P. = ₹99, gain % = $12\frac{1}{2}$% or $\frac{25}{2}$%

$$\therefore \quad \text{C.P.} = \left(\frac{100}{100 + \text{Gain}\%}\right) \times \text{S.P.}$$

$$= \left(\frac{100}{100 + \frac{25}{2}}\right) \times 99$$

$$= \left(\frac{100 \times 2}{225}\right) \times 99 = ₹88.$$

## SOME USEFUL SHORTCUT METHODS

1. If a man buys $x$ items for ₹$y$ and sells $z$ items for ₹$w$, then the gain or loss per cent made by him is

$$\left(\frac{xw}{zy} - 1\right) \times 100\%$$

**Explanation**

S.P. of $z$ iterms = ₹$w$

S.P. of $x$ items = ₹ $\frac{w}{z}x$

Net profit = $\frac{w}{z}x - y$.

$\therefore$ % Profit = $\dfrac{\frac{w}{z}x - y}{y} \times 100\%$

i.e., $\left(\dfrac{xw}{zy} - 1\right) \times 100\%$

which represents loss, if the result is negative.

***Note:***

In the case of gain per cent, the result obtained bears positive sign whereas in the case of loss per cent the result obtained bears sign negative.

How to Remember?

| Quantity | Price (C.P. or S.P.) |
|---|---|
| $x$ | $y$ |
| $z$ | $w$ |

1. Cross-multiply the numbers connected by the arrows ($xw$ and $zy$).
2. Mark the directon of the arrows for cross-multiplicaton. The arrow going down forms the numerator while the arrow going up forms the denominator $\left(\dfrac{xw}{zy}\right)$.

**Illustration 7:** If 11 oranges are bought for ₹10 and sold at 10 for ₹11, what is the gain or loss %?

**Solution:**

| Quantity | Price |
|---|---|
| 11 | 10 |
| 10 | 10 |

$$\% \text{ profit} = \left(\frac{xw}{zy} - 1\right) \times 100\%$$

$$= \left(\frac{11 \text{ x } 11}{10 \text{ x } 10} - 1\right) \times 100\%$$

$$= \frac{21}{100} \times 100\% = 21\%$$

**Illustration 8:** A fruit seller buys apples at the rate of ₹12 per dozen and sells them at the rate of 15 for ₹12. Find out his percentage gain or loss.

**Solution:**

| Quantity | Price |
|---|---|
| 12 | 12 |
| 12 | 12 |

$$\% \text{ gain or loss} = \left(\frac{xw}{zy} - 1\right) \times 100\%$$

$$= \left(\frac{12 \times 12}{15 \times 12} - 1\right) \times 100\%$$

$$= -\frac{36}{144} \times 100\% = -25\%$$

Since the sign is –ve, there is a loss of 25%

> 2. If the cost price of $m$ articles is equal to the selling price of $n$ articles, then
>
> % gain or loss = $\left(\dfrac{m - n}{n}\right) \times 100$
>
> [If $m > n$, it is % gain and, if $m < n$, it is % loss]

**Explanation**

Let, the C.P. of an article be ₹1.

$\therefore$ C.P. of $m$ articles = ₹$m \times 1$ = ₹$m$

$\because$ S.P. of $n$ articles = ₹$m$

$\therefore$ S.P. of an article = ₹$\dfrac{m}{n}$

$\therefore$ Profit on 1 article = ₹$\left(\dfrac{m}{n} - 1\right)$

i.e., ₹$\left(\dfrac{m - n}{n}\right)$

$\therefore$ % profit = $\left(\dfrac{m - n}{n}\right) \times 100$ i.e., $\left(\dfrac{m - n}{n}\right) \times 100$

**Illustration 9:** A shopkeeper professes to sell his goods on cost price, but uses 800 gm, instead of 1 Kg. What is his gain %?

**Solution:** Here, cost price of 1000 gm is equal to selling price of 800 gm,

$$\therefore \quad \% \text{ gain} = \left(\frac{m - n}{n}\right) \times 100$$

$$= \left(\frac{1000 - 800}{800}\right) \times 100$$

$$= \frac{200}{800} \times 100 = 25\%$$

**Illustration 10:** If the selling price of 12 articles is equal to the cost price of 18 articles, what is the profit %?

**Solution:** Here, $m = 18$, $n = 12$

$$\therefore \quad \text{Profit } \% = \left(\frac{m - n}{n}\right) \times 100$$

$$= \left(\frac{18 - 12}{12}\right) \times 100$$

$$= \frac{6}{12} \times 100 = 50\%$$

3. If an article is sold at a price S.P.$_1$., then % gain or % loss is $x$ and if it is sold at a price S.P$_2$., then % gain or % loss is $y$. If the cost price of the article is C.P., then

$$\frac{\text{S.P.}_1}{100+x} = \frac{\text{S.P.}_2}{100+y} = \frac{\text{C.P.}}{100} = \frac{\text{S.P.}_1 - \text{S.P.}_2}{x-y},$$

where $x$ or $y$ is –ve, if it indicates a loss, otherwise it is +ve.

**Illustration 11:** By selling a radio for ₹1536, Suresh lost 20%. What per cent shall he gain or lose by selling it for ₹2000?

**Solution:** Here, S.P.$_1$ = 1536, $x = -20$

(–ve sign indicates loss)

S.P.$_2$ = ₹2000, $y$ = ?

Using the formula:

$$\frac{\text{S.P.}_1}{100+x} = \frac{\text{S.P.}_2}{100+y},$$

we get, $\dfrac{1536}{100-20} = \dfrac{2000}{100+y}$

$\Rightarrow \quad 100 + y = \dfrac{2000 \times 80}{1536} = 104\dfrac{1}{6}$

$\Rightarrow \quad y = 4\dfrac{1}{6}\%$

Thus, Suresh has a gain of $4\frac{1}{6}$% by selling it for ₹2000.

4. If 'A' sells an article to 'B' at a gain/loss of $m$% and 'B' sells it to 'C' at a gain/loss of $n$%. If 'C' pays ₹$z$ for it to 'B', then the cost price for 'A' is

$$\left[\frac{100^2 z}{(100+m)(100+n)}\right]$$

where $m$ or $n$ is –ve, of it indicates a loss, otherwise it is +ve.

**Illustration 12:** Mohit sells a bicycle to Rohit at a gain of 10% and Rohit again sells it to Jyoti at a profit of 5%. If Jyoti pays ₹462 to Rohit, what is the cost price of the bicycle for Mohit?

**Solution:** Here, $m$ = 10, $n$ = 5, $z$ = ₹462.

Using the formula,

$$\text{C.P.} = \left[\frac{100^2 z}{(100+m)(100+n)}\right]$$

we get, C.P. for Mohit $= \left[\dfrac{100^2 \times 462}{(100+10)(100+5)}\right]$

$$= \frac{462 \times 10000}{110 \times 105} = ₹400.$$

**Illustration 13:** 'A' sells a DVD to 'B' at a gain of 17% and 'B' again sells it to 'C' at a loss of 25%. If 'C' pays ₹1053 to 'B', what is the cost price of the DVD to 'A'?

**Solution:** We have, $m$ = 17, $n$ = –25, $z$ = ₹1053.

∴ Cost price of DVD to

$$= \left[\frac{100^2 z}{(100+m)(100+n)}\right]$$

$$= \frac{100 \times 100 \times 1053}{(100+17)(100-25)}$$

$$= \frac{100 \times 100 \times 1053}{117 \times 75} = ₹1200.$$

5. If 'A' sells an article to 'B' at a gain/loss of $m$%, and 'B' sells it to 'C' at a gain/loss of $n$%, then the resultant profit/loss per cent is given by

$$\left(m + n + \frac{mn}{100}\right) \qquad \cdots(1)$$

Where $m$ or $n$ is –ve, if it indicates a loss, otherwise it is +ve.

***Note:***

The expression given by eq. (1) represents resultant profit or loss according as it is +ve or –ve.

**Illustration 14:** 'A' sells a horse to 'B' at a profit of 5% and 'B' sells it: to 'C' at a profit of 10%. Find out the resultant profit per cent.

**Solution:** We have, $m$ = 5 and $n$ = 10.

∴ Resultant profit % $= \left(m + n + \dfrac{mn}{100}\right)$

$$= \left(5 + 10 + \frac{5 \times 10}{100}\right)$$

$$= \frac{31}{2}\% \quad \text{or,} \quad 15\frac{1}{2}\%$$

**Illustration 15:** Manoj sells a shirt to Yogesh at a profit of 15%, and Yogesh sells it to Suresh at a loss of 10%. Find the resultant profit or loss.

**Solution:** Here, $m$ = 15, $n$ = –10

∴ Resultant profit/loss % $= \left(m + n + \dfrac{mn}{100}\right)$

$$= \left(15 - 10 + \frac{15 \times -10}{100}\right) = \left(15 - 10 - \frac{150}{100}\right)$$

$$= 7/2\% \quad \text{or} \quad 3\frac{1}{2}\%,$$

which represents profit as the sign is +ve.

6. When two different articles are sold at the same selling price, getting gain/loss of $x\%$ on the first and gain/loss of $y\%$ on the second, then the overall % gain or % loss in the transaction is given by

$$\left[\frac{100(x+y)+2xy}{(100+x)+(100+y)}\right]\%$$

The above expression represent overall gain or loss according as its sign is +ve or –ve.

7. When two different articles are sold at the same selling price getting a gain of $x\%$ on the first and loss of $x\%$ on the second, then the overall % loss in the transaction is given by

$$\left(\frac{x}{10}\right)^2\%$$

Note that in such questions, there is always a loss.

**Explanation**

Let, each article be sold at ₹$z$.

Since gain/loss of $x\%$ is made on the first, cost price of the first article

$$= ₹z\left(\frac{100}{100+x}\right)$$

Also, gain/loss of $y\%$ is made on the second. Therefore, cost price of the second article

$$= ₹z\left(\frac{100}{100+y}\right)$$

$\therefore$ Total C.P. $= z\left(\frac{100}{100+x}\right) + z\left(\frac{100}{100+y}\right)$

$$= z\left[\frac{100(100+y)+100(100+x)}{(100+x)(100+y)}\right]$$

Total S.P. $= 2z$.

$\therefore$ Overall % gain or loss $= \frac{\text{S.P.} - \text{C.P.}}{\text{C.P.}} \times 100$

$$= \frac{2z - \frac{100z[100+x+100+y]}{(100+x)(100+y)}}{\frac{100z[100+x+100+y]}{(100+x)(100+y)}} \times 100$$

$$= \frac{2(100+x)(100+y) - 100(200+x+y)}{100(200+x+y)} \times 100$$

$$= \frac{100x+100y+2xy}{(100+x)+(100+y)}\%$$

$$= \left[\frac{100(x+y)+2xy}{(100+x)+(100+y)}\right]\%.$$

***Note:***

In case $y = -x$, we have

Overall % gain or loss $= -\frac{x^2}{100}\%$,

Since the sign is –ve, there is always a loss.

**Illustration 16:** Mahesh sold two scooters, each for ₹24000. If he makes 20% profit on the first and 15% loss on the second, what is his gain or loss per cent in the transactions?

**Solution:** Here, $x = 20$ and $y = -15$.

$\therefore$ Over all gain/loss %

$$= \left[\frac{100(x+y)+2xy}{(100+x)+(100+y)}\right]\%$$

$$= \left[\frac{100(20-15)+2\times 20\times -15}{(100+20)+(100-15)}\right]\%$$

$$= -\frac{100}{205}\% = -\frac{20}{41}\%$$

which represents loss, being a –ve expression.

**Illustration 17:** Rajesh sold two horses for ₹990 each; gaining 10% on the one and losing 10% on the other. Find out his total gain or loss per cent.

**Solution:** Here, $x = 10$.

$\therefore$ Overall loss % $= \left(\frac{x}{10}\right)^2\% = \left(\frac{10}{10}\right)^2\% = 1\%$

8. A merchant uses faulty measure and sells his goods at gain/loss of $x\%$. The overall % gain/loss(g) is given by

$$\frac{100+g}{100+x} = \frac{\text{True measure}}{\text{Faulty measure}}$$

***Note:***

If the merchant sells his goods at cost price, then $x = 0$.

9. A merchant uses $y\%$ less weight/length and sells his goods at gain/loss of $x\%$. The overall % gain/loss is given by

$$\left[\left(\frac{y+x}{100-y}\right)\times 100\right]\%$$

**Illustration 18:** A dishonest shopkeeper professes to sell cloth at the cost price, but he uses faulty meter rod. His meter rod measures 95 cm only. Find his gain per cent.

**Solution:** Here, true measure = 100 cm.

False measure = 95 cm.

Since the shopkeeper sells the cloth at cost price, $\therefore x = 0$.

$\therefore$ Overall gain % is given by

$$\frac{100+g}{100+x} = \frac{\text{True measure}}{\text{Faulty measure}}$$

$$\Rightarrow \frac{100+g}{100} = \frac{100}{95} \Rightarrow 100 + g = \frac{100 \times 100}{95}$$

$$\Rightarrow g = \frac{10000}{95} - 100 = 5\frac{5}{19}\%$$

**Illustration 19:** A dishonest shopkeeper professes to sell his goods at cost price, but he uses a weight of 800 g for the Kg weight. Find out his gain per cent.

**Solution:** True measure = 1000 g.

False measure = 800 $g$. Also, $x = 0$.

$\therefore$ Overall gain % is given by

$$\frac{100+g}{100+x} = \frac{\text{True measure}}{\text{False measure}}$$

$$\Rightarrow \frac{100+\text{g}}{100} = \frac{1000}{800} \Rightarrow 100 + g = \frac{1000 \times 100}{800}$$

$$\Rightarrow g = \frac{1000}{8} - 100 = 25\%$$

**Illustration 20:** A shopkeeper sells goods at 44% loss on cost price, but uses 30% less weight. What is his percentage profit or loss?

**Solution:** Here, $x = -44$ and $y = 30$.

$$\therefore \text{ Overall gain/loss\%} = \left(\frac{y+x}{100-y}\right) \times 100\%$$

$$= \left(\frac{30-44}{100-30} \times 100\right)\%$$

$$= \left(\frac{-14}{70} \times 100\right)\% = -20\%,$$

which represents loss being a negative expression.

10. A person buys two items for ₹$A$ and sells one at a loss of $l\%$ and the other at a gain of $g\%$. If each item was sold at the same price, then

 (a) The cost price of the item sold at loss

$$= \frac{A(100 + \%\text{gain})}{(100 - \%\text{loss}) + (100 + \%\text{gain})}$$

 (b) The cost price of the item sold at gain

$$= \frac{A(100 - \%\text{loss})}{(100 - \%\text{loss}) + (100 + \%\text{gain})}$$

**Illustration 21:** Ramesh buys two books for ₹410. He sells one at a loss of 20% and the other at a gain of 25%. If both the books are sold at the same price, find out the cost price of two books.

**Solution:** Cost price of the book sold at a loss of 20%

$$= \frac{410\,(100+25)}{(100-20)+(100+25)}$$

$$= \frac{410 \times 125}{80+125} = ₹250.$$

Cost price of the book sold at a profit of 25%

$$= \frac{410\,(100-20)}{(100-20)+(100+25)} = \frac{410 \times 80}{80+125}$$

= ₹160.

11. If two successive discounts on an article are $m\%$ and $n\%$ respectively, then a single discount equivalent to the two successive discounts will be:

$$\left(m + n - \frac{mn}{100}\right)\%$$

**Explanation**

Let, the marked price of the article be ₹100.

$\therefore$ S.P. after the first discount = ₹$(100 - m)$ and discount at $n\%$ on ₹$(100 - m)$ = ₹$\frac{(100-m) \times n}{100}$.

$\therefore$ Single equivalent discount

$$= \left[m + \frac{(100-m) \times n}{100}\right]\%$$

$$= \left(\frac{100m + 100n - mn}{100}\right)\%$$

$$= \left(m + n - \frac{mn}{100}\right)\%$$

12. If three successive discounts on an article are $l\%$, $m\%$ and $n\%$ respectively, then a single discount equivalent to the three successive discounts will be

$$\left[l + m + n - \frac{(lm + ln + mn)}{100} + \frac{lmn}{100^2}\right]\%$$

**Explanation**

Let, the marked price of the article be ₹100.

∴ S.P. after the first discount = ₹(100 − $l$).

Second discount at $m$% on ₹(100 − $l$)

$$= ₹\frac{(100-l)\times m}{100}$$

∴ S.P. after second the discount

$$= ₹(100-l) - \frac{(100-l)m}{100}$$

$$= ₹\frac{100\,(100-l)-(100-l)\,m}{100}$$

$$= ₹\frac{(100-l)\cdot(100-m)}{100}$$

Third discount at $n\%$ on ₹$\dfrac{(100-l)\,(100-m)}{100}$

$$= ₹\frac{(100-l)\,(100-m)\,n}{100\times 100}$$

∴ S.P. after the third discount

$$= ₹\frac{(100-l)\,(100-m)}{100} - \frac{(100-l)\,(100-m)\,n}{100\times 100}$$

$$= ₹\frac{(100-l)\,(100-m)\,(100-n)}{100\times 100}$$

$$= \left(l+m+n-\frac{(lm+ln+mn)}{100}+\frac{lmn}{(100)^2}\right)$$

∴ Single equivalent discount

$$= \left(l+m+n-\frac{(lm+ln+mn)}{100}+\frac{lmn}{(100)^2}\right)\%$$

**Illustration 22:** Find a single discount equivalent to two successive discounts of 10% and 20%.

**Solution:** The equivalent single discount is given by

$$\left(10+20-\frac{10\times 20}{100}\right)\%, \text{ i.e., } 28\%$$

**Illustration 23:** Find out a single discount equivalent to three successive discounts of 10%, 20% and 30%.

**Solution:** The equivalent single discount is given by

$$\left(10+20+30-\frac{(10\times 20+10\times 30+20\times 30)}{100}+\frac{10\times 20\times 30}{100^2}\right)\%$$

i.e., $\left(60-11+\dfrac{6}{10}\right)\% = \dfrac{496}{10}\%$ or 49.6%

**Illustration 24:** Two shopkeepers sell machines at the same list price. The first allows two successive discounts of 30% and 16% and the second 20% and 26%. Which discount series is more advantageous to the buyers?

**Solution:** A single discount equivalent to the two successive discounts of 30% and 16% is

$$\left(30+16-\frac{30\times 16}{100}\right)\%$$

or, $\left(46-\dfrac{24}{5}\right)\%$ or, $41\dfrac{1}{5}\%$

Also, a single discount equivalent to the two successive discounts of 20% and 26% is

$$\left(20+26-\frac{20\times 26}{100}\right)\%$$

or, $\left(46-\dfrac{26}{5}\right)\%$ or $40\dfrac{4}{5}\%$

Clearly, the discount series being offered by the first shopkeeper is more advantageous to the buyers.

13. A shopkeeper sells an item at ₹$z$ after offering a discount of $d\%$ on labelled price. Had he not offered the discount, he would have earned a profit of $p\%$ on the cost price.

The cost price of each item is given by

$$\text{C.P.} = \left[\frac{100^2 z}{(100-d)\,(100+p)}\right].$$

**Illustration 25:** A shopkeeper sold sarees at ₹266 each after giving 5% discount on labelled price. Had he not given the discount, he would have earned a profit of 12% on the cost price. What was the cost price of each saree?

**Solution:** We have, labelled price $z$ = ₹266, discount $d$ = 5% and profit $p$ = 12%

Using the formula

$$\text{C.P.} = \left[\frac{100^2 z}{(100-d)\,(100+p)}\right]$$

we get the cost price of each saree

$$= \left[\frac{100\times 100\times 266}{(100-5)\,(100+12)}\right]$$

$$= \frac{100\times 100\times 266}{95\times 112} = ₹250.$$

## EXERCISE-I

1. Mohan buys a watch for ₹350 and sells it for ₹392. Find out his percentage of profit.

   (a) 9% (b) 12%
   (c) 14% (d) None of these

2. Ramesh purchased a bicycle for ₹5200 and spent ₹800 on its repairs. He had to sell it for ₹5500. Find out his profit or loss per cent.

   (a) $8\frac{1}{3}$% loss (b) $7\frac{1}{2}$% gain
   (c) 9% (d) None of these

3. A man buys 10 articles for ₹8 and sells them at ₹1.25 per article. His gain per cent is:

   (a) 55% (b) $56\frac{1}{4}$%
   (c) 40% (d) None of these

4. A toothpaste labeled at ₹80 is sold for ₹68. The rate of discount is:

   (a) 12% (b) 14%
   (c) 15% (d) None of these

5. Sardar Singh bought 200 dozen oranges at ₹10 a dozen. He spent ₹500 on transportation. He sold them at ₹1 each. What was his profit or loss per cent?

   (a) 4% (b) 6%
   (c) 5% (d) None of these

6. Mr Verma sold his scooter for ₹10500 at a gain of 5%. Find out the cost price of the scooter.

   (a) ₹10300 (b) ₹10700
   (c) ₹10000 (d) None of these

7. Suresh buys a camera for ₹1800 and sells it at 10% loss. Find out its selling price.

   (a) ₹1620 (b) ₹1730
   (c) ₹1650 (d) None of these

8. Hemant purchased 120 rims of paper at ₹80 per rim. He spent ₹280 on transportation, paid octroi at the rate of 40 paise per rim and paid ₹72 to the coolie. If he wants to have a gain of 8%, the selling price per rim must be:

   (a) ₹89 (b) ₹90
   (c) ₹95 (d) None of these

9. A shopkeeper loses 7% by selling a cricket ball for ₹31. For how much should he sell the ball so as to gain 5%?

   (a) ₹50 (b) ₹65
   (c) ₹35 (d) None of these

10. A shopkeeper sold some articles at ₹35 per piece and gained 40%. What would be the selling price of each article to earn 60% profit?

    (a) ₹40 (b) ₹45
    (c) ₹50 (d) None of these

11. A man bought apples at the rate of 6 for ₹20 and sold them at 4 for ₹16. His estimated profit % is:

    (a) 23% (b) 18%
    (c) 20% (d) None of these

12. A fruit vendor buys 10 bananas for ₹14 and sells them at 12 for ₹15. Find his percentage gain or loss.

    (a) $10\frac{5}{7}$% loss (b) $10\frac{5}{9}$% gain
    (c) 9% gain (d) None of these

13. If eggs are bought 12 for ₹10 and sold at 10 for ₹12. What is the gain or loss%.

    (a) 40% loss (b) 44% gain
    (c) 44% loss (d) None of these

14. If the cost price of 21 watches is equal to the selling price of 18 pieces, then what would be the gain per cent in this transaction?

    (a) $6\frac{1}{2}$% (b) 7%
    (c) $6\frac{2}{3}$% (d) None of these

15. A shopkeeper gains the cost of 8 metres thread by selling 40 metres thread. Find his gain per cent.

    (a) 19% (b) 20%
    (c) 22% (d) None of these

16. If the selling price of 2/3 of a certain quantity of milk be equal to the cost price of whole milk, then what will be the gain per cent in this transaction?

    (a) 50% (b) 48%
    (c) 53% (d) None of these

17. A shopkeeper sells 20 pencils for the same amount of money as he paid for 25 pencils. What is his gain per cent?

    (a) 20% (b) 25%
    (c) 24% (d) None of these

**18.** Mohit lost 18% by selling a bicycle for ₹1230. What per cent shall he gain or loss by selling it for ₹1600?

(a) $6\frac{2}{3}$% loss (b) 4% gain

(c) $6\frac{2}{3}$% gain (d) None of these

**19.** A shopkeeper sells an article at a gain of 10%. Had he sold it at a loss of 20%, its selling price would have been ₹180 less. What is the cost price of the article?

(a) ₹630 (b) ₹600
(c) ₹580 (d) None of these

**20.** A person sells 36 oranges per ₹1 and makes a loss of 4%. Find how many oranges per ₹ to be sold to have a gain of 8%?

(a) 1/32 (b) 5
(c) 1/16 (d) None of these

**21.** A person sells a colour TV at 10% below the cost price. Had he received ₹1494 more, he would have made a profit of $12\frac{1}{2}$%. What was the cost price of the colour TV?

(a) ₹6400 (b) ₹7200
(c) ₹6640 (d) None of these

**22.** Vijay sold a watch at a gain of 5%. Had he sold it for ₹72 more, he would have gained 13%. Find out the cost price of the watch.

(a) ₹900 (b) ₹910
(c) ₹870 (d) None of these

**23.** Sita sells a calculator to Gita at a gain of 17% and Gita sells it to Anu at a loss of 25%. If Anu pays ₹1842.75 for it, then what did Sita pay for it?

(a) ₹2080 (b) ₹2100
(c) ₹2110 (d) None of these

**24.** 'A' buys an article and sells it to 'B' at a profit of 10%, 'B' sells it to 'C' gaining 20%. If 'C' gives ₹924, what amount did 'A' give?

(a) ₹700 (b) ₹724
(c) ₹780 (d) None of these

**25.** 'A' sells an article to 'B' at a gain of 20% and 'B' sells it to 'C' at a gain of 10% and 'C' sells it to 'D' at a gain of $12\frac{1}{2}$%. If 'D' pays ₹29.70 what did it cost to 'A'?

(a) ₹20 (b) ₹24
(c) ₹18 (d) None of these

**26.** Rajesh sells taperecorder to Mihir at a loss of 10% and Mihir sells it to Shiv at a loss of 20%. If Shiv pays ₹1440 for it, at what price did Rajesh buy?

(a) ₹1920 (b) ₹2000
(c) ₹1800 (d) None of these

**27.** A man sells a scooter to his friend at 10% loss. If the friend sells it for ₹54000 and gains 20%, find out the original cost price of the scooter.

(a) ₹50000 (b) ₹45000
(c) ₹40000 (d) None of these

**28.** 'A' sells a good to 'B' at a profit of 10% and B sells it to 'C' at a profit of 20%. Find out the resultant profit.

(a) ₹35% (b) 20%
(c) ₹32% (d) None of these

**29.** A manufacturer sells an article to a wholesale dealer at a profit of 20%. The wholesale dealer sells it to a retail merchant at a loss of 5%. Find out the resultant profit or loss.

(a) 14% loss (b) 14% gain
(c) 12% gain (d) None of these

**30.** A man sold two watches for ₹3750 each. On one he gained 5%, and on the other, he lost 5%. What was his total gain or loss percentage?

(a) $1\frac{1}{4}$% (b) $\frac{1}{2}$%

(c) $\frac{1}{4}$% (d) None of these

**31.** A men sells two houses at the rate of ₹1.995 Lakhs each. On one house he gains 20% and on the other he loses 20%. His gain or loss per cent in the whole transaction is:

(a) 5% loss (b) 4%
(c) 4% loss (d) None of these

**32.** A shopkeeper sold two bicycles for ₹1500 each. On one, he gains 25% and on the other he loses 20%. His gain or loss per cent in the whole transaction is:

(a) $2\frac{18}{41}$% loss (b) $2\frac{18}{41}$% gain
(c) 2% gain (d) None of these

**33.** A man sells two articles, each for ₹640. He earns 20% profit on the first, and 40% profit on the second. Find his overall per cent profit.

(a) $29\frac{1}{2}$% (b) $28\frac{1}{2}$%

(c) $29\frac{3}{13}$% (d) None of these

**34.** A person sells two articles, each for ₹1040. He incurs 20% loss on the first and 10% loss on the second. Find out overall per cent loss.

(a) $12\frac{5}{17}\%$ (b) $15\frac{5}{17}$

(c) $13\frac{3}{4}\%$ (d) None of these

**35.** A grocer sells rice at a profit of 20% and uses a weight which is 25% less. Find out overall gain percentage.

(a) 60% (b) 65%
(c) 58% (d) None of these

**36.** A shopkeeper sells goods at 10% loss on cost price, but uses 20% less weight. What is his profit or loss percentage?

(a) 2% gain (b) $2\frac{1}{2}\%$ loss

(c) $2\frac{1}{2}\%$ gain (d) None of these

**37.** A cloth merchant says that due to slump in the market, he sells cloth at 10% loss, but he uses a inaccurate metre scale and actually gains 15%. Find out the actual length of the scale.

(a) 72.4 cm (b) 71.34 cm
(c) 78.25 cm (d) None of these

**38.** A cloth dealer professes to sell cotton at cost price, but uses a meter having a length of 80 cm only and charges for the meter. Find his gain per cent.

(a) 25% (b) 30%
(c) 40% (d) None of these

**39.** Sudeep buys two CDs for ₹380 and sells one at a loss of 22% and the other at a gain of 12%. If both the CDs are sold at the same price, then the cost price of two CDs is:

(a) ₹196, ₹225 (b) ₹230, ₹140
(c) ₹224, ₹156 (d) None of these

**40.** An article is listed at ₹65. A customer bought this article for ₹56.16 and received two successive discounts of which one is 10%. Find out the other discount in this discount scheme offered by the shopkeeper.

(a) 4% (b) 3%
(c) 6% (d) None of these

**41.** A cash payment that will settle a bill for 250 chairs at ₹50 per chair less 20% and 15% with a further discount of 5% on cash payment is:

(a) ₹7025 (b) ₹8075
(c) ₹8500 (d) None of these

**42.** A person sells taperecorders at ₹1134 each after giving a discount of 19% on the marked price. Had he not given the discount, he would have earned a profit of 40% on the cost price. The cost price of each taperecorder is:

(a) ₹1000 (b) ₹1200
(c) ₹1400 (d) None of these

## Exercise-2
## (Based on Memory)

**1.** The profit earned after selling an article for ₹536 is the same as the loss incurred after selling the article for ₹426. What is the cost price of the article?

(a) ₹448 (b) ₹470
(c) ₹481 (d) ₹500
(e) None of these

**[Andhra Bank PO, 2007]**

**2.** The cost of manufacturing an article was ₹900. The trader wants to gain 25% after giving a discount of 10%. The marked price must be:

(a) ₹1500 (b) ₹1250
(c) ₹1200 (d) ₹1000

**[SSC (GL) Prel. Examination, 2005]**

**3.** By selling a table for ₹350 instead of ₹400, loss per cent increases by 5%. The cost price of the table is:

(a) ₹1050 (b) ₹417.50
(c) ₹435 (d) ₹1000

**[SSC (GL) Prel. Examination, 2005]**

**4.** By selling a plot of land for ₹45000, a person loses 10%. At what price should he sell it to gain 15%?

(a) ₹50000 (b) ₹55000
(c) ₹57500 (d) ₹60000

**[SSC (GL) Prel. Examination, 2005]**

**5.** A man bought pencils at the rate of 6 for ₹4 and sold them at the rate of 4 for ₹6. His gain in the transaction is:

(a) 75% (b) 80%
(c) 125% (d) 100%

**[SSC (GL) Prel. Examination, 2005]**

**6.** If an article is sold for ₹178 at a loss of 11%, then what should be its selling price in order to earn a profit of 11%?

(a) ₹220.50 (b) ₹267
(c) ₹222 (d) ₹220

**[SSC (GL) Prel. Examination, 2005]**

**7.** A dealer sold two T.V. sets for ₹7400 each. On one, he gained 10% and on the other, he lost 10%. The dealer's loss or gain in the transaction was:

(a) no profit no loss (b) 1% gain
(c) 0.1% loss (d) 1% loss

**[SSC (GL) Prel. Examination, 2005]**

**8.** A shopkeeper purchased rice of 3 varieties *a*, *b*, *c* which cost ₹34.50, ₹28.60 and ₹32.40 per Kg respectively. In which of the following bargain he will earn the maximum?

(a) He purchased *a* and *c* each 20 Kg and sold them at ₹38.00 and ₹36.00 per Kg respectively
(b) He purchased *a* and *b* 30 Kg and 40 Kg respectively and sold them at ₹37.00 and ₹33.00 per Kg respectively
(c) He purchased *b* and *c* 20 Kg and 40 Kg respectively and sold them at ₹40.00 and ₹38.00 per Kg respectively
(d) He purchased *c* and *a* 25 Kg and 30 Kg respectively and sold them at ₹42.00 and ₹38.00 per Kg respectively
(e) He purchased b and a 40 Kg and 20 Kg respectively and sold them at ₹37.00 and ₹40.00 per Kg respectively

**[SBI PO, 2005]**

**9.** The profit earned after selling an article for ₹625 is the same as the loss incurred after selling the article for ₹435. What is the cost price of the article?

(a) ₹530 (b) ₹520
(c) ₹540 (d) ₹550
(e) None of these

**[Bank of Baroda PO, 2007]**

**10.** Srinivas sold an article for ₹460 and earned a profit of 15%. At what price should it have been sold so as to earn a profit of 20%?

(a) ₹483 (b) ₹480
(c) ₹498 (d) ₹485
(e) None of these

**[PNB Management Trainee, 2007]**

**11.** The profit earned after selling a wristwatch for ₹5765 is the same as the loss incurred after selling the wristwatch for ₹4315. What is the cost price of the wristwatch?

(a) ₹6000 (b) ₹5100
(c) ₹4900 (d) ₹5040
(e) None of these

**[OBC PO, 2007]**

**12.** A trader sells 145 metre of cloth for ₹12325 at the profit of ₹10 per metre of cloth. What is the cost price of 1 metre of cloth?

(a) ₹65 (b) ₹75
(c) ₹95 (d) ₹85
(e) None of these

**[SBI PO, 2008]**

**13.** The profit earned after selling an article for ₹522 is the same as the loss incurred after selling the article for ₹378. What is the cost price (in ₹) of the article?

(a) ₹4602 (b) ₹4903
(c) ₹520 (d) ₹5505
(e) None of these

**[Corporation Bank PO, 2007]**

**14.** What per cent of selling price would be 34% of cost price if gross profit is 26% of the selling price?

(a) 17.16 (b) 74.00
(c) 25.16 (d) 88.40
(e) None of these

**[BSRB Bangalore PO, 2000]**

**15.** Mr. Gupta, Mr. Shastri and Mr Saxena together earned ₹19800. The ratio of earnings between Mr. Gupta and Mr. Shastri is 2:1 while that between Mr. Shastri and Mr. Saxena is 3:2. How much did Mr. Shastri earn?

(a) ₹3600 (b) ₹5400
(c) ₹1800 (d) ₹6300
(e) None of these

**[BSBR Bangalore PO, 2000]**

**16.** A grocer purchased 20 Kg of wheat at the rate of ₹15 per Kg and 30 Kg of wheat at the rate of ₹13 per Kg. At what price per Kg should he sell the mixture to earn $33\frac{1}{3}\%$ profit on the cost price?

(a) ₹28.00 (b) ₹20.00
(c) ₹18.40 (d) ₹17.40
(e) None of these

**[BSRB Delhi PO, 2000]**

**17.** By selling an article for ₹96, double the profit is obtained than the profit that would have been obtained

by selling it for ₹84. What is the cost price of the article?

(a) ₹72.00 (b) ₹75.00
(c) ₹70.00 (d) ₹68.00
(e) None of these

**[BSRB Delhi PO, 2000]**

**18.** A shopkeeper sells a T.V. set for ₹16560 at 10% discount on its marked price and earns 15% profit. If no discount is offered then what will be his per cent profit?

(a) $27\frac{7}{9}$ (b) $22\frac{7}{9}$
(c) $25\frac{7}{9}$ (d) Data inadequate
(e) None of these

**[BSRB Patna PO, 2001]**

**19.** A shopkeeper sold an article offering a discount of 5% and earned a profit of 23.5%. What would have been the percentage of profit earned if no discount had been offered?

(a) 28.5 (b) 24.675
(c) 30 (d) Data inadequate
(e) None of these

**[Andhra Bank SO, 2002]**

**20.** A shopkeeper sold a TV set for ₹17940, at a discount of 8% and gained 19.6%. If no discount is allowed, what will be his gain per cent?

(a) 25% (b) 36.4%
(c) 24.8% (d) Cannot be determined
(e) None of these

**[RBI Grade 'B' Officers, 2002]**

**21.** A man sold two watches for ₹240 each; on one he gained 20% and on the other he lost 20%. The gain or loss per cent in the transaction is:

(a) 1% gain (b) 1% loss
(c) 4% gain (d) 4% loss

**[SI of Police Rec. Examination, 1997]**

**22.** Mohan sells two tape recorders at the same price. On one he gains 10% and on the other he loses 10%. The total gain or loss in transaction is:

(a) 1% gain (b) 1% loss
(c) No loss or no gain (d) 2% loss

**[SI of Police Rec. Examination, 1997]**

**23.** A man bought a car for ₹60000 and spent 10% of the cost of the car for purchase of new tyres. At what price should he sell the car to make a gain of 15%?

(a) ₹79,500 (b) ₹74,500
(c) ₹75,900 (d) ₹73,500

**[SI of Police Rec. Examination, 1997]**

**24.** A merchant bought 60 sheeps at ₹120 per sheep. He sold 40 of them at ₹150 each. 10 of them died. What should be the selling price of the remaining sheeps if he wants a profit of ₹800?

(a) ₹150 (b) ₹200
(c) ₹250 (d) ₹180

**[SI of Police Rec. Examination, 1997]**

**25.** A merchant allows 10% for each payment on the marked price of an article and still gains at the rate of 10%. The cost price of an article which is marked as ₹77 is:

(a) ₹70 (b) ₹60
(c) ₹63 (d) ₹62.37

**[SI of Police Rec. Examination, 1997]**

**26.** The price of a jewel, passing through three hands, rises on the whole to 65%. If the first and the second sellers earned 20% and 25% profit respectively, the profit earned by the third seller is:

(a) 20% (b) 15%
(c) 10% (d) 5%

**[SI of Police Rec. Examination, 1997]**

**27.** A shopkeeper professes to sell his goods at cost price but uses a weight of 800 g instead of kilogram weight. Thus, he makes a profit of:

(a) 2% (b) 8%
(c) 20% (d) 25%

**[SI of Police Rec. Examination, 1997]**

**28.** If selling price of an article is $\frac{4}{3}$ of its cost price, the profit in transaction is:

(a) $\frac{1}{3}\%$ (b) $20\frac{1}{2}\%$
(c) $33\frac{1}{3}\%$ (d) $25\frac{1}{2}\%$

**[SI Rec. Examination (D.P.), 1997]**

**29.** A grocer mixes 26 Kg of tea which costs ₹20 a Kg with 30 Kg of tea which costs ₹36 a Kg and sells the mixture at ₹30 a Kg. His profit per cent is:

(a) 5% (b) 6%
(c) 7% (d) 8%

**[SI Rec. Examination (D.P.), 1997]**

**30.** If the cost price of 15 tables be equal to the selling price of 20 tables, the loss per cent in the transaction is:

(a) 18% (b) 20%
(c) 25% (d) 24%

**[SI Rec. Examination (D.P.), 1997]**

**31.** If 5% more is gained by selling an article for ₹350 then by selling it for ₹340, the cost of the article (in rupees) is:

(a) 50 (b) 160
(c) 200 (d) 225

**[SI Rec. Examination (D.P.), 1997]**

**32.** On selling an article for ₹700, the loss is 20%. To make a profit of 20%, the article must be sold at:

(a) ₹1050 (b) ₹850
(c) ₹1075 (d) ₹875

**[SI Rec. Examination (D.P.), 1997]**

**33.** A man purchased a box full of pencils at the rate of 7 for ₹9 and sold all of them at the rate of 8 for ₹11. In this transaction, he gained ₹10. How many pencils did the box contain?

(a) 100 (b) 112
(c) 114 (d) 115

**[SI Rec. Examination (D.P.), 1997]**

**34.** The cost price of 16 articles is equal to selling price of 12 of them. The gain or loss per cent in the transaction is:

(a) $33\frac{1}{3}$% loss (b) $23\frac{1}{3}$% loss
(c) $33\frac{1}{3}$% gain (d) $23\frac{1}{3}$% gain

**[SI Rec. Examination (D.P.), 1997]**

**35.** A businessman marks his goods in such a way that even after allowing 12.5% discount on cash purchase, he gains 20%. If the cost price of the goods is ₹140, the marked price is:

(a) ₹162 (b) ₹172
(c) ₹192 (d) ₹198

**[SI Rec. Examination (D.P.), 1997]**

**36.** A watch is sold for ₹880 at a loss of 20%. For how much should it be sold to gain 10%?

(a) ₹1000 (b) ₹1100
(c) ₹1210 (d) ₹1400

**[SI Rec. Examination (D.P.), 1997]**

**37.** Applied to a bill for ₹15000, the difference (in ₹) between a discount of 50% and two successive discount of 30% and 20% is:

(a) 0 (b) 450
(c) 900 (d) 1000

**[SI Rec. Examination (D.P.), 1997]**

**38.** A sum of ₹2430 was divided among three persons X, Y, Z such that if their shares were diminished by ₹5, would be in the ratio 3:4:5. In this division, X got:

(a) ₹1015 (b) ₹810
(c) ₹605 (d) ₹595

**[Assistant's Grade Examination, 1997]**

**39.** The ratio between the annual incomes of A and B is 4:3 and between their annual expenditures is 3 : 2. If at the end of a year both save ₹600 each, find the difference in the income.

(a) ₹450 (b) ₹500
(c) ₹600 (d) ₹750

**[Assistant's Grade Examination, 1997]**

**40.** If 3 toys are sold at the cost price of 4 toys of the same kind, the profit will be:

(a) 25% (b) $33\frac{1}{3}$%
(c) $66\frac{2}{3}$% (d) 50%

**[SSC (GL) Prel. Examination, 2000]**

**41.** A sells a bicycle to B at a profit of 20%. B sells it to C at a profit of 25%. If C pays ₹225 for it, the cost price of the bicycle for A is:

(a) ₹110 (b) ₹125
(c) ₹120 (d) ₹150

**[SSC (GL) Prel. Examination 2000, (MS)]**

**42.** A retailer buys 40 pens at the marked price of 36 pens from a whole-saler. If he sells these pens giving a discount of 10%, what is the profit per cent?

(a) 9% (b) 10%
(c) $10\frac{1}{9}$% (d) 11%

**[SSC (GL) Prel. Examination, 2000]**

**43.** 12 copies of a book were sold for ₹1800, thereby gaining cost price of 3 copies. The cost price of a copy is:

(a) ₹120 (b) ₹150
(c) ₹1200 (d) ₹1500

**[SSC (GL) Prel. Examination, 2000]**

**44.** A shopkeeper marks his sharees at 20% above the cost price and allows a purchaser a discount of 10% for cash buying. What profit per cent does he make?

(a) 18 (b) 12
(c) 10 (d) 8

**[SSC (GL) Prel. Examination, 2000]**

**45.** A shopkeeper purchased a chair marked at ₹800, at two successive discounts of 10% and 15%,

respectively. He spent ₹28 on transportation and sold the chair for ₹800. His gain per cent is:

(a) 40 (b) 30
(c) 25 (d) 14

**[SSC (GL) Prel. Examination, 2000]**

**46.** The selling price of 5 articles is same as the cost price of 3 articles. The gain or loss is:

(a) 20% gain (b) 25% gain
(c) 33.33% loss (d) 40% loss

**[SSC (GL) Prel. Examination, 2000]**

**47.** By selling an article for ₹480 *A* lost 20%. For what should he sell it to make a profit of 20%?

(a) ₹800 (b) ₹760
(c) ₹720 (d) ₹680

**[SSC (GL) Prel. Examination, 2000]**

**48.** A house worth ₹150000 is sold by X at 5% profit to Y. Y sells the house back to X at a 2% loss. Then, in the entire transaction:

(a) X gains ₹4350 (b) X loses ₹4350
(c) X gains ₹3150 (d) X loses ₹3150

**[SSC (GL) Prel. Examination, 2000]**

**49.** A shopkeeper purchases 12 balloons for ₹10 and sells them at 10 balloons for ₹12. Thus, he earns a profit of:

(a) 35% (b) 36%
(c) 44% (d) 45%

**[SSC (GL) Prel. Examination, 2000]**

**50.** Anu sold 2 books at ₹1.40 each. Her profit on one was 20% and her loss on the other was 20%. Then, she:

(a) made no gain no loss (b)Gained 20 paise
(c) Lost 20 paise (d)lost 12 paise

**[SSC (GL) Prel. Examination, 2000]**

**51.** If I had purchased 11 articles for ₹10 and sold all articles at the rate of 10 for ₹11, the profit per cent would have been:

(a) 10% (b) 11%
(c) 21% (d) 100%

**[SSC (GL) Prel. Examination, 2002]**

**52.** By selling an article for ₹72, there is a loss of 10%. In order to gain 5%, its selling price should be:

(a) ₹87 (b) ₹85
(c) ₹80 (d) ₹84

**[SSC (GL) Prel. Examination, 2002]**

**53.** An article is sold at a loss of 10%. Had it been sold for ₹9 more, there would have been a gain of $12\frac{1}{2}$ % on it. The C.P. of the article is:

(a) ₹40 (b) ₹45
(c) ₹50 (d) ₹35

**[SSC (GL) Prel. Examination, 2002]**

**54.** If C.P. is ₹80, overhead is ₹20 and S.P. is ₹120, then profit per cent is:

(a) 20% (b) 50%
(c) 40% (d) 30%

**[SSC (GL) Prel. Examination, 2002]**

**55.** If S.P. of an article is $\frac{8}{5}$ times its C.P., the profit per cent on it is:

(a) 120% (b) 160%
(c) 40% (d) 60%

**[SSC (GL) Prel. Examination, 2002]**

**56.** A man sells two articles at ₹99 each. On one he gains 10% and on the other he loses 10%. What is his gain or loss per cent in the whole transaction?

(a) Loss, 1% (b) Loss, 1.5%
(c) Profit, 1% (d) Profit, 1.5%

**[SSC (GL) Prel. Examination, 2002]**

**57.** The cost price of 18 articles is equal to S.P. of 15 articles. The gain per cent is:

(a) 15% (b) 20%
(c) 25% (d) 18%

**[SSC (GL) Prel. Examination, 2002]**

**58.** If a person sells a sari for ₹5200, making a profit of 30%, then the cost price of sari is:

(a) ₹4420 (b) ₹4000
(c) ₹3900 (d) ₹3800

**[SSC (GL) Prel. Examination, 2002]**

**59.** The ratio of the cost price and the selling price is 4:5. The profit per cent is:

(a) 10% (b) 20%
(c) 25% (d) 30%

**[SSC (GL) Prel. Examination, 2002]**

**60.** Two bicycles were sold for ₹3990 each, gaining 5% on one and losing 5% on the other. The gain or loss per cent on the whole transaction is:

(a) neither gain nor loss (b)2.5% gain
(c) 2.5% loss (d) 0.25% loss

**[SSC (GL) Prel. Examination, 2002]**

**61.** If the S.P. of 40 articles is equal to the C.P. of 50 articles, then the loss or gain per cent is:

(a) 25% loss (b) 20% loss
(c) 25% gain (d) 20% gain

**[SSC (GL) Prel. Examination, 2003]**

**62.** A man bought a second hand machine for ₹1200 and spent ₹200 on its repairs. He sold it for ₹1680. His profit per cent is:

(a) 20% (b) 10%
(c) 8% (d) 16%

**[SSC (GL) Prel. Examination, 2003]**

**63.** An item costing ₹840 was sold by a shop-keeper at a gain of 10% and it was again sold by the new buyer at a loss of 5%. Find S.P. of the item:

(a) ₹877.80 (b) ₹798
(c) ₹924 (d) ₹37.80

**[SSC (GL) Prel. Examination, 2003]**

**64.** 100 oranges are bought for ₹350 and sold at the rate of ₹48 per dozen. The per cent of profit or loss is:

(a) 12% loss (b) 15% gain
(c) $14\frac{2}{7}$% loss (d) $14\frac{2}{7}$% profit

**[SSC (GL) Prel. Examination, 2003]**

**65.** A merchant fixes the sale price of his goods at 15% above the cost price. He sells his goods at 12% less than the fixed price. His percentage of profit is:

(a) $2\frac{1}{2}$ (b) $1\frac{1}{5}$
(c) $1\frac{1}{2}$ (d) 2

**[SSC (GL) Prel. Examination, 2003]**

**66.** If the ratio of C.P. and S.P. is 5:6. The gain % is:

(a) 20% (b) $33\frac{1}{3}$%
(c) 25% (d) 30%

**[SSC (GL) Prel. Examination, 2003]**

**67.** Ramesh bought a gas stove and paid 10% less than its original price. He sold it at 30% profit on the price he had paid what percentage of profit did Ramesh earn on the original price?

(a) 32% (b) 11%
(c) 20% (d) 17%

**[IBPS JR. Executive, 2002]**

**68.** A builder purchased a plot of land for ₹80 Lakhs and constructed a five storey building inclusive of ground floor on it. How much should he charge for each flat to make 25% profit on his investment on land, if there are five flats on each storey?

(a) ₹50000 (b) ₹100000
(c) ₹500000 (d) ₹2000000
(e) None of these

**[IBPS JR. Executive, 2002]**

**69.** 20% loss on selling price is what per cent loss on the cost price?

(a) 25% (b) $16\frac{2}{3}$%
(c) 15% (d) $16\frac{1}{3}$%

**[SSC (GL), 2011]**

**70.** X sells two articles for ₹4,000 each with no loss and no gain in the interaction. If one was sold at a gain of 25% the other is sold at a loss of:

(a) 25% (b) $18\frac{2}{9}$%
(c) $16\frac{2}{3}$% (d) 20%

**[SSC (GL), 2011]**

**71.** A man purchased some eggs at 3 for ₹5 and sold them at 5 for ₹12. Thus, he gained ₹143 in all. The number of eggs he bought is:

(a) 210 (b) 200
(c) 195 (d) 190

**[SSC (GL), 2011]**

**72.** The cost price of an article is 64% of the marked price. The gain percentage after allowing a discount of 12% on the marked price is:

(a) 37.5% (b) 48%
(c) 50.5% (d) 52%

**[SSC (GL), 2011]**

**73.** By selling an article for ₹144, a person gained such that the percentage gain equals the cost price of the article. The cost price of the article is:

(a) ₹90 (b) ₹80
(c) ₹75 (d) ₹60

**[SSC (GL), 2011]**

**74.** A man sells two article for ₹5000 each neither losing nor gaining in the deal. If he sold one of them at a gain of 25%, the other article is sold at a loss of:

(a) $15\frac{2}{3}$% (b) $16\frac{2}{3}$%
(c) $17\frac{1}{3}$% (d) $18\frac{1}{3}$%

**[SSC (GL), 2011]**

**75.** A man bought orange at the rate of 8 for ₹34 and sold them at the rate of 12 for ₹57. How many oranges should be sold to earn a net profit of ₹45?

(a) 90 (b) 100
(c) 135 (d) 150

**[SSC (GL), 2011]**

**76.** A shopkeeper allows 23% commission on his advertised price and still makes a profit of 10%. If he gains ₹56 on one item. His advertised price of the item, in ₹, is:

(a) 820 (b) 780
(c) 790 (d) 800

**[SSC (GL), 2011]**

**77.** A shopkeeper earns a profit of 12% on selling a book at 10% discount on the printed price. The ratio of the cost price and the printed price of the book is:

(a) 45:56 (b) 45:51
(c) 47:56 (d) 47:51

**[SSC (GL), 2010]**

**78.** On selling an article for ₹170, a shopkeeper loses 15%. In order to gain 20%, he must sell that article at rupees:

(a) 215.50 (b) 212.50
(c) 240 (d) 210

**79.** Seema purchased an item for ₹9600 and sold it for loss of 5 per cent. From that money she purchased another item and sold it for gain of 5 per cent. What is her overall gain/loss?

(a) Loss of ₹36 (b) Profit of ₹24
(c) Loss of ₹54 (d) None of these

**[Bank of Baroda PO Examination, 2011]**

**80.** By Selling 80 ball pens for ₹140, a retailer loses 30%. How many ball pens should he sell for ₹104 so as to make a profit of 30%?

(a) 32 (b) 52
(c) 48 (d) 42

**81.** What profit/loss per cent did Ravi earn if he purchased an item of ₹5600 and sold it at 3/4 of its cost price?

(a) Loss of 20 per cent
(b) Gain of 25 per cent
(c) Neither gain nor loss
(d) None of these

**[OBC PO Examination, 2010]**

**82.** The profit earned after selling an article for ₹996 is the same as loss incurred after selling the article for ₹894. What is the cost price of the article?

(a) ₹935 (b) ₹905
(c) ₹945 (d) ₹975
(e) None of these

**[SBI PO Examination, 2008]**

**83.** Naresh purchased TV set of ₹11250 after getting discount of 10% on the labeled price. He spent ₹150 on transport and ₹800 on installation. At what price should it be sold so that the profit earned would have been 15% if no discount was offered?

(a) ₹12937.50 (b) ₹14030
(c) ₹13450 (d) ₹15467.50

**[United Bank of India PO Examination, 2009]**

**84.** A shopkeeper sells notebooks at the rate of ₹45 each and earns a commission of 4%. He also sells pencil box at the rate of ₹80 each and earns a commission of 20%. How much amount of commission will he earn in two weeks if he sells 10 notebooks and 6 pencil boxes a day?

(a) ₹1956 (b) ₹1586
(c) ₹1496 (d) ₹1596
(e) None of these

**[CBI PO Examination, 2010)]**

**85.** A shopkeeper bought 30 Kg of wheat at the rate of ₹45 per Kg. He sold 40% of the total quantity at the rate of ₹50 per Kg. Approximately, at what price per Kg should he sell the remaining quantity to make 25 per cent overall profit ?

(a) ₹54 (b) ₹52
(c) ₹50 (d) ₹60

**[Allahabad Bank PO Examination, 2010]**

**86.** A shopkeeper sold an item at 10% loss after giving a discount equal to half the marked price. The cost price of the item is:

(a) $\frac{1}{9}$ of marked price

(b) $\frac{4}{9}$ of marked price

(c) $\frac{5}{9}$ of marked price

(d) $\frac{7}{9}$ of marked price

**[SSC, 2014]**

**87.** A person purchased a saree for ₹7710 after availing a net discount of ₹1285. The percentage of discount, the saree-shop offers, is:

(a) $14\frac{1}{7}\%$ (b) $14\frac{2}{7}\%$

(c) $14\frac{3}{7}\%$ (d) $14\frac{4}{7}\%$

**[SSC, 2014]**

**88.** A cycle dealer offers a discount of 10% and still makes a profit of 26%. What does he pay for a cycle whose marked price is ₹840?

(a) ₹600 (b) ₹650
(c) ₹700 (d) ₹750

**[SSC, 2014]**

**89.** If the cost price of an item is $\frac{2}{5}$ of its marked price and if it is sold at a discount of 10%, then there will be:

(a) 25% profit (b) 40% profit
(c) 50% profit (d) 125% profit

**[SSC, 2014]**

**90.** An item costing ₹200 is being sold at 10% loss. If the price is further reduced by 5%, the selling price will be:

(a) ₹170 (b) ₹171
(c) ₹175 (d) ₹179

**[SSC, 2014]**

**91.** A shopkeeper buys 144 items at 90 paisa each. On the way 20 items are broken. He sells the remainder at ₹1.20 each. His gain per cent correct to one place of decimal is:

(a) 13.8% (b) 14.6%
(c) 14.8% (d) 15.8%

**[SSC, 2014]**

**92.** There is a profit of 20% on the cost price of an article. The per cent of profit, when calculated on selling price is:

(a) $16\frac{2}{3}\%$ (b) 20%

(c) $33\frac{1}{3}\%$ (d) None of these

**[SSC, 2014]**

**93.** By selling an article for ₹102, there is a loss of 15%. When the article is sold for ₹134.40, the net result in the transaction is:

(a) 12% gain (b) 12% loss
(c) 10% loss (d) 15% gain

**[SSC, 2014]**

**94.** Two toys are sold at ₹504 each. One toy brings the dealer a gain of 12% and the other a loss of 4%. The gain or loss per cent by selling both the toys is:

(a) $3\frac{5}{13}\%$ Profit (b) $4\frac{5}{13}\%$ Profit

(c) $5\frac{1}{13}\%$ Profit (d) $2\frac{3}{13}\%$ Loss

**[SSC, 2014]**

**95.** A sold a horse to B for ₹4800 by losing 20%. B sells it to C at a price which would have given A a profit of 15%. B's gain is:

(a) ₹1800 (b) ₹1900
(c) ₹2000 (d) ₹2100

**[SSC, 2014]**

**96.** A reduction of 21% in the price of an item enables a person to buy 3 Kg more for ₹100. The reduced price of the item per Kg is:

(a) ₹5.50 (b) ₹7.50
(c) ₹10.50 (d) ₹7.00

**[SSC, 2014]**

**97.** A tradesman marks his goods 30% more than the cost price. If he allows a discount of $6\frac{1}{4}\%$ then his gain per cent is:

(a) $23\frac{3}{4}\%$ (b) 22%

(c) $21\frac{7}{8}\%$ (d) 30%

**[SSC, 2013]**

**98.** A shopkeeper purchased a chair marked at ₹600 at two successive discounts of 15% and 20%. He spent ₹28 on transportation and sold the chair for ₹545. His gain per cent was:

(a) 25% (b) 30%
(c) 35% (d) 20%

**[SSC, 2013]**

**99.** The marked price of a piano was ₹15,000. At the time of sale, there were successive discounts of 20% 10% and 10% on it. The sale price was:

(a) ₹9,720 (b) ₹9,750
(c) ₹9,760 (d) ₹9,780

**[SSC, 2013]**

**100.** By selling 25 metres of cloth a trader gains the selling price of 5 metres of cloth. The gain of the trader in % is:

(a) 25 (b) 20
(c) 28 (d) 29

**[SSC, 2013]**

**101.** A sells a suitcase to B at 10% profit. B cells it to C at 30% profit. If C pays ₹2,860 for it, then the price at which A bought it is:

(a) ₹1,000 (b) ₹1,600
(c) ₹2,000 (d) ₹2,500

**[SSC, 2013]**

**102.** Gita buys a plot of land for ₹96,000. She sells $\frac{2}{5}$ of it at a loss of 6%. She wants to make a profit of 10% on the whole transaction by selling the remaining land. The gain percentage on the remaining land is:

(a) 20 (b) $20\frac{2}{3}$
(c) 14 (d) 7

**[SSC, 2013]**

**103.** An article is sold at a gain of 15%. Had it been sold for ₹27 more, the profit would have been 20%. The cost price of the article is:

(a) ₹500 (b) ₹700
(c) ₹540 (d) ₹545

**[SSC, 2013]**

**104.** On selling 17 balls at₹720, there is a loss equal to the cost price of 5 balls. The cost price of a ball is:

(a) 45 (b) 50
(c) 55 (d) 60

**[SSC, 2013]**

**105.** Two items A and B are sold at a profit of 10% and 15%, respectively. If the amount of profit received is the same, then the cost price of A and B may be:

(a) ₹1,000, ₹1,500 (b) ₹5,000, ₹2,000
(c) ₹3,000, ₹2,000 (d) ₹3,000, ₹5,000

**[SSC, 2013]**

**106.** Arun marks up the computer he is selling by 20% profit and sells them at a discount of 15%. Arun's net gain per cent is:

(a) 4 (b) 2
(c) 3.5 (d) 2.5

**[SSC Assistant Grade III, 2013]**

**107.** A dealer buys a table listed at ₹1,500 and gets successive discounts of 20% and 10%. He spends ₹20 on transportation and sells at a profit of 20%. Find the selling price of the table.

(a) ₹1,320 (b) ₹1,080
(c) ₹1,200 (d) ₹1,230

**[SSC Assistant Grade III, 2013]**

**108.** A sells an article to B at a gain of 20% and B sells it to C at a gain of 10% and C sells it to D at a gain of $12\frac{1}{2}$%. If D pays ₹29.70, then A purchased the article for:

(a) ₹40 (b) ₹10
(c) ₹20 (d) ₹30

**[SSC Assistant Grade III, 2013]**

**109.** By selling 80 ball pens for ₹140 a retailer loses 30%. How many ball pens should he sell for ₹104 so as to make a profit of 30%?

(a) 32 (b) 52
(c) 48 (d) 42

**[SSC Assistant Grade III, 2013]**

**110.** A discountof 40% on the marked price of atrouser enables Ajit to purchase a shirt also which costs him ₹320. How much did Ajit payfor the trouser?

(a) ₹ 480 (b) ₹ 540
(c) ₹ 800 (d) ₹ 400

**[SSC Assistant Grade III, 2012]**

**111.** Rahim bought a gift item for ₹510 after getting a discount of 15%. He then sells it 5% above the marked price. The profit earned in this deal is:

(a) ₹150 (b) ₹120
(c) ₹100 (d) ₹90

**[SSC Assistant Grade III, 2012]**

**112.** A shopkeeper marks his goods at 40% above their cost price. He is able to sell $\frac{3}{4}$th of his goods at this price, and the remaining at 40% discount. Assuming that the shopkeeper is able to sell the goods he buys, find his loss or gain as % of the whole transaction.

(a) 20% loss (b) 23% loss
(c) 26% gain (d) 30% gain

**[SSC Assistant Grade III, 2012]**

**113.** A fruit seller bought 240 bananas at the rate of ₹48 per dozen. He sells half of them at the rate of ₹5 per banana, $\frac{1}{6}$th of the remaining are found to be rotten. The price per banana at which he has to sell the remaining bananas to get a profit of 25% on his entire investment is:

(a) ₹5.5 (b) ₹6.0
(c) ₹5.0 (d) ₹6.5

**[SSC Assistant Grade III, 2012]**

**114.** A and B started a business by investing ₹3,50,000 and ₹1,40,000 respectively. A gets 20% of the yearly profit for managing the business. Thereafter the profit is divided in the ratio of the capital. If A receives totally ₹38,000 more than B at the end of a year, then the profit is:

(a) ₹28,000 (b) ₹2,80,000
(c) ₹1,05,000 (d) ₹70,000

**[SSC, 2012]**

**115.** A fan in a shop is offered at a discount of 10%. It is sold during clearance sale at 6% discount over the already discounted price at ₹846. The original marked price of the fan is:

(a) ₹1000 (b) ₹900
(c) ₹850 (d) ₹896

**[SSC, 2012]**

**116.** A trader allows a trade discount of 20% and a cash discount of $6\frac{1}{4}\%$ on the marked price of the goods and gets a net gain of 20% of the cost. By how much above the cost should the goods be marked for the sale?

(a) 40% (b) 50%
(c) 60% (d) 70%

**[SSC, 2012]**

**117.** A discount series of 10%, 20% and 40% is equal to a single discount of:

(a) 56.80% (b) 50%
(c) 70% (d) 43.20%

**[SSC, 2012]**

**118.** Tarun bought a TV with 20% discount on the labelled price. Had he bought it with 25% discount, he would have saved ₹500. At what price did he buy the TV?

(a) ₹7,500 (b) ₹8,500
(c) ₹8,000 (d) ₹7,400

**[SSC, 2012]**

**119.** A manufacturer sells an article to a wholesale dealer at a profit of 10%. The wholesale dealer sells it to a shopkeeper at 20% profit. The shopkeeper sells it to a customer for ₹56,100 at a loss of 15%. Then the cost price of the article to the manufacturer is:

(a) ₹25,000 (b) ₹10,000
(c) ₹50,000 (d) ₹55,000

**[SSC, 2012]**

**120.** A loss of 19% gets converted into a profit of 17% when the selling price is increased by ₹162. The cost price of the article is:

(a) ₹450 (b) ₹600
(c) ₹360 (d) ₹540

**[SSC, 2012]**

**121.** A man purchased 150 pens at the rate of ₹12 per pen. He sold 50 pens at gain of 10%. The percentage gain at which he must sell the remaining pens so as to gain 15% on the whole outlay is:

(a) $21\frac{1}{2}\%$ (b) 20%
(c) 17% (d) $17\frac{1}{2}\%$

**[SSC, 2012]**

**122.** A dealer sold two types of goods for ₹10,000 each. On one of them, he lost 20% and on the other he gained 20%. His gain or loss per cent in the entire transaction was:

(a) 2% loss (b) 2% gain
(c) 4% gain (d) 4% loss

**[SSC, 2012]**

**123.** The cost price of 40 articles is the same as the selling price of 25 articles. Find the gain per cent.

(a) 65% (b) 60%
(c) 15% (d) 75%

**[SSC, 2012]**

**124.** A sells an article to B making a profit of $\frac{1}{5}th$ his outlay. B sells it to C, gaining 20%. If C sells it for ₹600 and incurs a loss of $\frac{1}{6}th$ his outlay, the cost price of A is:

(a) ₹600 (b) ₹500
(c) ₹720 (d) ₹800

**[SSC, 2012]**

**125.** A man had a certain amount with him. He spent 20% of that to buy an article and 5% of the remaining on transport. Then he gifted ₹120. If he is left with ₹1,400, the amount he spent on transport is:

(a) ₹76 (b) ₹61
(c) ₹95 (d) ₹80

**[SSC, 2012]**

**126.** By selling an article at $\frac{3}{4}th$ of the marked price, there is gain of 25%. The ratio of the marked price and the cost price is:

(a) 5:3 (b) 3:5
(c) 3:4 (d) 4:3

**[SSC, 2011]**

**127.** Successive discounts of 10%, 20% and 50% will be equivalent to a single discount of:

(a) 36% (b) 64%
(c) 80% (d) 56%

**[SSC, 2011]**

**128.** A retailer offers the following discount schemes for buyers on an article:

I. Two successive discounts of 10%.
II. A discount of 12% followed by a discount of 8%.
III. Successive discounts of 15% and 5%.
IV. A discount of 20%.

The selling price will be minimum under the scheme

(a) I (b) II
(c) III (d) IV

**[SSC, 2011]**

**129.** The value of an article depreciates every year at the rate of 10% of its value. If the present value of the article is ₹729, then its worth 3 years ago was:

(a) ₹1250 (b) ₹1000
(c) ₹1125 (d) ₹1200

**[SSC, 2011]**

**130.** Nitin bought some oranges at ₹40 a dozen and an equal number at ₹30 a dozen. He sold them at ₹45 a dozen and made a profit of ₹480. The number of oranges, he bought, was:

(a) 48 (b) 60
(c) 72 (d) 84

**[SSC, 2011]**

**131.** A man buys two chairs for a total cost of ₹900. By selling one for $\frac{4}{5}$ of its cost and the other for $\frac{5}{4}$ of its cost, he makes a profit of ₹90 on the whole transaction. The cost of the lower priced chair is:

(a) ₹360 (b) ₹400
(c) ₹420 (d) ₹300

**[SSC, 2011]**

**132.** By selling 100 oranges, a vendor gains the selling price of 20 oranges. He gain per cent is:

(a) 20 (b) 25
(c) 30 (d) 32

**[SSC, 2011]**

**133.** 60% of the cost price of an article is equal to 50% of its selling price. Then the percentage of profit or loss on the cost price is:

(a) 20% loss (b) $16\frac{2}{3}$% profit
(c) 20% profit (d) 10% loss

**[SSC, 2011]**

**134.** Maninder bought two horses at ₹40,000 each. He sold one horse at 15% gain, but had to sell the second horse at a loss. If he had suffered a loss of ₹3,600 on the whole transaction, then the selling price of the second horse is:

(a) ₹30,000 (b) ₹30,200
(c) ₹30,300 (d) ₹30,400

**[SSC, 2011]**

**135.** A fruit-seller buys $x$ guavas for ₹$y$ and sells $y$ guavas for ₹$x$. If $x>y$, then he made:

(a) $\frac{x^2-y^2}{xy}$% loss (b) $\frac{x^2-y^2}{xy}$% gain
(c) $\frac{x^2-y^2}{y^2}$% loss (d) $\frac{x^2-y^2}{y^2}\times 100$% gain

**[SSC, 2011]**

**136.** A person sold a horse at a gain of 15%. Had he bought it for 25% less and sold it for ₹60 less, he would have made a profit of 32%. The cost price of the horse was:

(a) ₹370 (b) ₹372
(c) ₹375 (d) ₹378

**[SSC, 2010]**

**137.** A sells an article to B at a gain of 25%, B sells it to C at a gain 20% and C sells it to D at a gain of 10%. If D pays ₹330 for it, how much did it cost A?

(a) ₹200 (b) ₹250
(c) ₹275 (d) ₹290

**[SSC, 2010]**

**138.** By selling an article for ₹21, a man lost such that the percentage loss was equal to the cost price. The cost price of the article was:

(a) ₹30 or ₹70 (b) ₹35 or ₹60
(c) ₹45 (d) ₹50

**[SSC, 2010]**

**139.** Half of 100 articles were sold at a profit of 20% and the rest at a profit of 40%. If all of the articles had been sold at a profit of 25%, the total profit would have been ₹100 less than earlier profit. The cost price of each article was:

(a) ₹10 (b) ₹15
(c) ₹20 (d) ₹30

**[SSC, 2010]**

**140.** The marked price of a clock is ₹3200. It is to be sold at ₹2448 at two successive discounts. If the first discount is 10%, then the second discount is:

(a) 5% (b) 10%
(c) 15% (d) 20%

**[SSC, 2010]**

**141.** A dealer marks his goods 30% above his cost price and then allows 15% discount on it. What is the cost price of an article on which he gains ₹84?

(a) ₹800 (b) ₹560
(c) ₹373.33 (d) ₹280

**[SSC, 2010]**

**142.** A shopkeeper wishes to give 5% commission on the marked price of an article but also wants to earn

a profit of 10%. If his cost price is ₹95, then the marked price is:

(a) ₹100 (b) ₹110
(c) ₹120 (d) ₹130

**[SSC, 2010]**

**143.** A shopkeeper sells sugar in such a way that the selling price of 950 g of sugar is the same as the cost price of 1 Kg of sugar. What is his gain per cent?

(a) $5\frac{5}{19}$ (b) $5\frac{1}{5}$
(c) 5 (d) $4\frac{1}{19}$

**[SSC, 2010]**

**144.** A person bought a horse and a carriage for ₹20000. Later, he sold the horse at 20% profit and the carriage at 10% loss. Thus, he gained 2% in the whole transaction. The cost price of the horse was:

(a) ₹7200 (b) ₹7500
(c) ₹8000 (d) ₹9000

**[SSC, 2010]**

**145.** A sells an article to B at 15% profit. B sells it to C at 10% loss. If C pays ₹517.50 for it then A purchased it at:

(a) ₹500 (b) ₹750
(c) ₹1000 (d) ₹1250

**[SSC, 2010]**

**146.** An article is sold at a certain fixed price. By selling it at $\frac{2}{3}$ of that price, one loses 10%. The gain per cent on selling it at the original price is:

(a) 20 (b) $33\frac{1}{3}$
(c) 35 (d) 40

**[SSC, 2010]**

**147.** A sells an article to B for ₹45,000 losing 10% in the transaction. B sells it to C at a price which would have given a profit of 10% to A. By what per cent does B gain?

(a) $\frac{75}{2}$ (b) $\frac{100}{3}$
(c) $\frac{200}{9}$ (d) $\frac{150}{7}$

**[SSC, 2010]**

**148.** The cost price of an article is 80% of its marked price for sale. How much per cent does the tradesman gain after allowing a discount of 12%?

(a) 20 (b) 12
(c) 10 (d) 8

**[SSC, 2010]**

**149.** A merchant purchases a wrist watch for ₹450 and fixes its list price in such a way that after allowing a discount of 10%, he earns a profit of 20%. Then the list price (in rupees) of the wrist watch is:

(a) ₹500 (b) ₹600
(c) ₹750 (d) ₹800

**[SSC, 2010]**

**150.** A, B, C are partners in a business. During a particular year, A received one third of the profit, B received $\frac{1}{4}$ of the profit and C received the remaining ₹5000. How much amount of money did A receive?

(a) ₹1000 (b) ₹3000
(c) ₹4000 (d) ₹5000

**[SSC, 2010]**

**151.** A bakery bakes cake with the expectation that it will earna profit of 40% by selling each cake at marked price. But during the delivery to showroom 16% of the cakes were completely damaged and hence could not be sold. 24% of the cakes were slightly damaged and hence could be sold at 80% of the cost price. The remaining 60% of the cakes were sold at marked price. What is the percentage profit in the whole consignment?

(a) 3.2 (b) 2.4
(c) 2.8 (d) 4.2
(e) 3.6

**[IBPS PO/MT, 2014]**

**152.** A shopkeeper sells two watches for ₹308 each. On one watch he earns 12% profit and on the others he suffers 12% loss. His profit or loss in the entire transaction was:

(a) $1\frac{11}{25}$% loss (b) $1\frac{11}{25}$% gain
(c) $3\frac{2}{25}$% loss (d) $3\frac{2}{25}$% gain
(e) None of these

**[IBPS PO/MT, 2013]**

**153.** An article was purchased for ₹78,350. Its price was marked up by 30%. It was sold at a discount of 20% on the marked-up price. What was the profit per cent on the cost price?

(a) 4% (b) 7%
(c) 5% (d) 3%
(e) 6%

**[IBPS PO/MT, 2012]**

**154.** Profit earned by an organization is distributed among officers and clerks in the ratio of 5:3. If the number of officers is 45 and the number of clerks is 80 and the amount received by each officer is ₹25,000, what was the total amount of profit earned?

(a) ₹22 Lakhs (b) ₹18.25 Lakhs
(c) ₹18 Lakhs (d) ₹23.25 Lakhs
(e) None of these

**[SBI Associates Banks PO, 2011]**

**155.** A shopkeeper labeled the price of his articles in order to earn a profit of 30% on the cost price. He, then, sold the articles by offering a discount of 10% on the labelled price. What is the actual rate of profit he earned in the deal?

(a) 18% (b) 15%
(c) 20% (d) Cannot be determined
(e) None of these

**[SBI Associates Banks PO, 2011]**

**156.** Kamya purchased an item for ₹46,000 and sold it at aloss of 12 per cent. With that amount she purchased another item which he sold at a gain of 12%. What was her overall gain/loss?

(a) Loss of ₹662.40 (b) Profit of ₹662.40
(c) Loss of ₹642.80 (d) Profit of ₹642.80
(e) None of these

**[Allahabad Bank PO, 2011]**

**157.** Rehaan purchased a bike for ₹54,000. He sold it at a loss of 8%. With that money, he again purchased another bike and sold that at a profit of 10 per cent. What is his overall loss/profit?

(a) loss ₹657 (b) profit ₹567
(c) loss ₹648 (d) profit₹648
(e) None of these

**[Corporation Bank PO, 2011]**

**158.** A shopkeeper sells notebooks at the rate of ₹457 each and earns a commission of 4%. He also sells pencil boxes at the rate of ₹80 each and earns a commission of 20%. How much amount of commission will he earn in two weeks if he sells 10 notebooks and 6 pencil boxes a day?

(a) ₹1,956 (b) ₹1,586
(c) ₹1,496 (d) ₹1,596
(e) None of these

**[CBI PO, 2010]**

**159.** Meenal purchased a car for ₹2,50,000 and sold it for ₹3,48,000. What is the per cent profit she made on the car?

(a) 40 (b) 39.2
(c) 38.4 (d) 38
(e) None of these

**[Corporation Bank PO, 2010]**

**160.** A shopkeeper bought 30 Kg of wheat at the rate of ₹45 per Kg. He sold 40% of the total quantity at the rate of ₹50 per Kg. Approximately, at what price per Kg should he sell the remaining quantity to make 25 per cent overall profit?

(a) ₹54 (b) ₹52
(c) ₹50 (d) ₹60
(e) ₹56

**[Allahabad Bank PO, 2010]**

**161.** The profit earned after selling a wrist watch for ₹4,080 is the same as the loss incurred after selling the same wrist watch for ₹3,650. What is the cost price of the wrist watch?

(a) ₹3,785 (b) ₹3,800
(c) ₹3,775 (d) ₹3,865
(e) None of these

**[NABARD Bank Officer, 2009]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (a) | **3.** (b) | **4.** (c) | **5.** (a) | **6.** (c) | **7.** (a) | **8.** (b) | **9.** (c) | **10.** (a) | **11.** (c) | **12.** (a) | **13.** (b) |
| **14.** (c) | **15.** (b) | **16.** (a) | **17.** (b) | **18.** (c) | **19.** (b) | **20.** (a) | **21.** (c) | **22.** (a) | **23.** (b) | **24.** (a) | **25.** (a) | **26.** (b) |
| **27.** (a) | **28.** (c) | **29.** (b) | **30.** (c) | **31.** (c) | **32.** (a) | **33.** (c) | **34.** (b) | **35.** (a) | **36.** (c) | **37.** (c) | **38.** (a) | **39.** (c) |
| **40.** (a) | **41.** (b) | **42.** (a) | | | | | | | | | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (b) | **3.** (d) | **4.** (c) | **5.** (c) | **6.** (c) | **7.** (d) | **8.** (c) | **9.** (a) | **10.** (b) | **11.** (d) | **12.** (b) | **13.** (e) |
| **14.** (c) | **15.** (b) | **16.** (c) | **17.** (a) | **18.** (a) | **19.** (c) | **20.** (e) | **21.** (d) | **22.** (b) | **23.** (c) | **24.** (b) | **25.** (c) | **26.** (c) |
| **27.** (d) | **28.** (c) | **29.** (a) | **30.** (c) | **31.** (c) | **32.** (a) | **33.** (b) | **34.** (c) | **35.** (c) | **36.** (c) | **37.** (c) | **38.** (c) | **39.** (c) |
| **40.** (b) | **41.** (d) | **42.** (b) | **43.** (a) | **44.** (d) | **45.** (c) | **46.** (d) | **47.** (c) | **48.** (a) | **49.** (c) | **50.** (d) | **51.** (a) | **52.** (d) |
| **53.** (a) | **54.** (a) | **55.** (d) | **56.** (a) | **57.** (b) | **58.** (b) | **59.** (c) | **60.** (d) | **61.** (c) | **62.** (a) | **63.** (a) | **64.** (d) | **65.** (b) |
| **66.** (a) | **67.** (d) | **68.** (d) | **69.** (b) | **70.** (d) | **71.** (c) | **72.** (a) | **73.** (b) | **74.** (b) | **75.** (a) | **76.** (d) | **77.** (a) | **78.** (c) |
| **79.** (d) | **80.** (a) | **81.** (d) | **82.** (c) | **83.** (b) | **84.** (d) | **85.** (d) | **86.** (c) | **87.** (b) | **88.** (a) | **89.** (d) | **90.** (b) | **91.** (c) |
| **92.** (a) | **93.** (a) | **94.** (a) | **95.** (d) | **96.** (d) | **97.** (c) | **98.** (a) | **99.** (a) | **100.** (a) | **101.** (c) | **102.** (b) | **103.** (c) | **104.** (d) |
| **105.** (c) | **106.** (b) | **107.** (a) | **108.** (c) | **109.** (a) | **110.** (a) | **111.** (b) | **112.** (c) | **113.** (b) | **114.** (d) | **115.** (a) | **116.** (c) | **117.** (a) |
| **118.** (c) | **119.** (c) | **120.** (a) | **121.** (d) | **122.** (d) | **123.** (b) | **124.** (b) | **125.** (d) | **126.** (a) | **127.** (b) | **128.** (d) | **129.** (b) | **130.** (a) |
| **131.** (d) | **132.** (b) | **133.** (c) | **134.** (d) | **135.** (d) | **136.** (c) | **137.** (a) | **138.** (a) | **139.** (c) | **140.** (c) | **141.** (a) | **142.** (b) | **143.** (a) |
| **144.** (c) | **145.** (a) | **146.** (c) | **147.** (c) | **148.** (c) | **149.** (b) | **150.** (c) | **151.** (a) | **152.** (a) | **153.** (a) | **154.** (d) | **155.** (e) | **156.** (a) |
| **157.** (d) | **158.** (e) | **159.** (b) | **160.** (d) | **161.** (d) | | | | | | | | |

## EXPLANATORY ANSWERS

### Exercise-1

**1.** **(b)** Here, C.P. = ₹350, S.P. = ₹392

Profit = S.P. − C.P. = 392 − 350 = ₹42.

$$\therefore \quad \text{Profit \%} = \frac{\text{Profit} \times 100}{\text{C.P.}} = \frac{42 \times 100}{350} = 12\%$$

**2.** **(a)** C.P. of the bicycle = 5200 + 800 = ₹6000

S.P. = ₹5500. Since S.P. < C.P.,

∴ Loss = C.P. − S.P. = 6000 − 5500 = ₹500.

$$\therefore \quad \text{Loss \%} = \frac{\text{Loss} \times 100}{\text{C.P.}} = \frac{500 \times 100}{6000}$$

$$= \frac{25}{3}\% \text{ or } 8\frac{1}{3}\%$$

**3.** **(b)** Cost price of 10 articles (C.P.) = ₹8.

Selling price of 10 articles (S.P.) = 1.25 × 10

= ₹12.50

Profit = S.P. − C.P. = 12.50 − 8 = ₹4.50.

$$\therefore \quad \text{Gain \%} = \frac{\text{Gain} \times 100}{\text{C.P}} = \frac{4.50 \times 100}{8} = 56\frac{1}{4}\%$$

**4.** **(c)** Marked price (M.P.) = ₹80.

Selling price (S.P.) = ₹68.

Discount = M.P. − S.P. = 80 − 68 = ₹12.

$$\therefore \quad \text{Rate of discount} = \frac{\text{Discount} \times 100}{\text{Marked Price}} = \frac{12 \times 100}{80} = 15\%$$

**5.** **(a)** Cost price of 200 dozen oranges = 200 × 10 = ₹2000

Transportation cost = ₹500.

$\therefore$ Cost Price (C.P.) = 2000 + 500 = ₹2500.

Selling Price (S.P.) = 200 × 12 × 1 = ₹2400.

Loss = C.P. − S.P. = 2500 − 2400 = ₹100.

$\therefore$ Loss % $= \dfrac{\text{Loss} \times 100}{\text{C.P.}} = \dfrac{100 \times 100}{2500} = 4\%$

**6.** **(c)** We have, S.P. = ₹10500, gain% = 5%

$$\therefore \text{ C.P.} = \left(\frac{100}{100 + \text{Gain\%}}\right) \times \text{S.P.}$$

$$= \left(\frac{100}{100 + 5}\right) \times 10500$$

$$= \frac{100}{105} \times 10500 = ₹10000.$$

**7.** **(a)** Here, C.P. = ₹1800, loss % = 10%

$$\therefore \text{ S.P.} = \left(\frac{100 - \text{Loss\%}}{100}\right) \times \text{C.P.}$$

$$= \left(\frac{100 - 10}{100}\right) \times 1800$$

$$= \frac{90}{100} \times 1800 = ₹1620.$$

**8.** **(b)** We have,

Cost price (C.P.) = (120 × 80 + 280 + 72 + 120 × 40) = ₹10000.

Gain % = 8%

$\therefore$ Selling Price (S.P.) of 120 rims

$$= \left(\frac{100 + \text{Gain\%}}{100}\right) \times \text{C.P.}$$

$$= \left(\frac{100 + 8}{100}\right) \times 10000$$

$$= \frac{108}{100} \times 10000 = ₹10800.$$

Thus, selling price per rim $= \dfrac{10800}{120} = ₹90.$

**9.** **(c)** In the first case, S.P. = ₹31 and loss % = 7%

$$\therefore \text{ C.P.} = \left(\frac{100}{100 - \text{Loss\%}}\right) \times \text{S.P.} = \left(\frac{100}{100 - 7}\right) \times 31$$

$$= \frac{100}{93} \times 31 = ₹\,33\frac{1}{3}.$$

In the second case, C.P. = ₹ $33\frac{1}{3}$ and gain % = 5%

$$\therefore \text{ S.P.} = \left(\frac{100 + \text{Gain\%}}{100}\right) \times \text{C.P.}$$

$$= \left(\frac{100 + 5}{100}\right) \times \frac{100}{3} = \frac{105}{100} \times \frac{100}{3} = ₹35.$$

**10.** **(a)** In the first case, we have, S.P. = ₹35 and gain % = 40%

$$\therefore \text{ C.P.} = \left(\frac{100}{100 + \text{Gain\%}}\right) \times \text{S.P.}$$

$$= \left(\frac{100}{100 + 40}\right) \times 35$$

$$= \frac{100}{140} \times 35 = ₹25.$$

In the second case, C.P. = ₹25 and gain% = 60%

$$\therefore \text{ S.P.} = \left(\frac{100 + \text{Gain\%}}{100}\right) \times \text{C.P.}$$

$$= \left(\frac{100 + 60}{100}\right) \times 25$$

$$= \frac{160}{100} \times 25 = ₹40.$$

**11.** **(c)** Quantity Price

6 20

6 16

$$\%\text{ profit} = \left(\frac{xw}{zy} - 1\right) \times 100\% = \left(\frac{6 \times 16}{4 \times 20}\right) \times 100\%$$

$$= \frac{16}{80} \times 100\%$$

$$= 20\%$$

**12.** **(a)** Quantity Price

10 14

12 15

$$\%\text{ gain or loss} = \left(\frac{xw}{zy} - 1\right) \times 100\%$$

$$= \left(\frac{10 \times 15}{12 \times 14} - 1\right) \times 100\%$$

$$= \left(\frac{150}{168} - 1\right) \times 100\%$$

$$= -\frac{18}{168} \times 100\% = -10\frac{5}{7}\%$$

Since the sign is −ve, since there is a loss of $10\frac{5}{7}$ %.

**13.** **(b)** Quantity Price

12 10

10 12

$$\%\text{ gain or loss} = \left(\frac{xw}{zy} - 1\right) \times 100\%$$

$$= \left(\frac{12 \times 12}{10 \times 10} - 1\right) \times 100\% = \left(\frac{144}{100} - 1\right) \times 100\%$$

$= \frac{44}{100} \times 100\% = 44\%$

Since the sign is +ve, therefore there is a profit of 44%.

**14.** **(c)** Here, $m = 21$, $n = 18$.

$\therefore$ Gain% $= \left(\frac{m-n}{n}\right) \times 100 = \left(\frac{21-18}{18}\right) \times 100$

$$= \left(\frac{3}{18} \times 100\right)\% = 16\frac{2}{3}\%$$

**15.** **(b)** Here, $m = 48$, $n = 40$.

$\therefore$ Gain % $= \left(\frac{m-n}{n}\right) \times 100 = \left(\frac{48-40}{40}\right) \times 100$

$$= \frac{8}{40} \times 100 = 20\%$$

**16.** **(a)** Let, the quantity of milk be $x$ litre.

Then, $m = x$, $n = \frac{2}{3}x$.

$\therefore$ Gain % $= \left(\frac{m-n}{n}\right) \times 100 = \left(\frac{x - \frac{2}{3}x}{\frac{2}{3}x}\right) \times 100$

$$= \frac{1}{2} \times 100 = 50\%$$

**17.** **(b)**Here, $m = 25$, $n = 20$.

$\therefore$ % gain $= \left(\frac{m-n}{n}\right) \times 100 = \left(\frac{25-20}{20}\right) \times 100$

$= 25\%$

**18.** **(c)** Here, S.P.$_1$ = ₹1230, $x = -18$,

S.P.$_2$ = ₹1600, $y$ = ?

Using the formula,

$$\frac{\text{S.P.}_1}{100+x} = \frac{\text{S.P.}_2}{100+y}$$

we get, $\frac{1230}{100-18} = \frac{1600}{100+y}$

$\Rightarrow$ $100 + y = \frac{1600 \times 82}{1230} = 106\frac{2}{3} \Rightarrow y = 6\frac{2}{3}\%6\frac{2}{3}\%$

Thus, Mohit has a gain of $6\frac{2}{3}$% by selling it for ₹1600.

**19.** **(b)** Here, S.P.$_1$ − S.P.$_2$ = ₹180, $x = 10$, $y = -20$,

C.P. = ?

Using the formula, $\frac{\text{C.P.}}{100} = \frac{\text{S.P.}_1 - \text{S.P.}_2}{x-y}$

we get, C.P. $= \left(\frac{180}{10+20}\right) \times 100 = \frac{180}{30} \times 100 =$ ₹600.

**20.** **(a)** We have,

S.P$_1$ = Selling price of one orange = ₹ $\frac{1}{36}$,

$x = -4$, $y = 8$.

Using the formula, $\frac{\text{S.P.}_1}{100+x} = \frac{\text{S.P.}_2}{100+y}$

we get, $\frac{1/36}{100-4} = \frac{\text{S.P.}_2}{100+8}$ $\Rightarrow$ S.P.$_2$ $= \frac{108}{96} \times \frac{1}{36} = \frac{1}{32}$.

**21.** **(c)** Here, S.P.$_1$ − S.P.$_2$ = −1494, $x = -10$, $y = \frac{25}{2}$.

Using the formula,

$$\frac{\text{C.P.}}{100} = \frac{\text{S.P}_1 - \text{S.P}_2}{x-y}$$

we get, $\frac{\text{C.P.}}{100} = \frac{-1494}{-10-25/2} = \frac{1494}{45/2}$

$\Rightarrow$ C.P. $= \frac{1494 \times 2 \times 100}{45} =$ ₹6640.

**22.** **(a)** Here, S.P.$_1$ − S.P.$_2$ = −72, $x = 5$, $y = 13$.

Using the formula,

$$\frac{\text{C.P.}}{100} = \left(\frac{\text{S.P.}_1 - \text{S.P.}_2}{x-y}\right)$$

we get, $\frac{\text{C.P.}}{100} = \left(\frac{-72}{5-13}\right)$

$\Rightarrow$ C.P. $= \frac{72}{8} \times 100 =$ ₹900.

**23.** **(b)** Here, $m = 17$, $n = -25$, $z$ = ₹1842.75.

$\therefore$ Cost price of calculator to Sita

$= \left[\frac{100^2 z}{(100+m)(100+n)}\right] = \frac{100 \times 100 \times 1842.75}{(100+17)(100-25)}$

$= \frac{100 \times 100 \times 1842.75}{117 \times 75} =$ ₹2100.

**24.** **(a)** We have, $m = 10$, $n = 20$, $z$ = ₹924.

$\therefore$ Cost price of A

$= \left[\frac{100^2 z}{(100+m)(100+n)}\right]$

$= \left[\frac{100 \times 100 \times 924}{(100+10)(100+20)}\right] = \frac{100 \times 100 \times 924}{110 \times 120}$

= ₹700.

**25.** **(a)** Here, $m = 20$, $n = 10$, $p = \frac{25}{2}$,

z = ₹29.70.

$\therefore$ Cost price of $A$

$= \left[\frac{100^3 z}{(100+m)(100+n)(100+p)}\right]$

$= \left(\frac{100 \times 100 \times 100 \times 29.70 \times 2}{120 \times 110 \times 225}\right)$

$= \left(\frac{100 \times 100 \times 100 \times 29.70 \times 2}{120 \times 110 \times 225}\right) =$ ₹20.

**26.** **(b)** We have, $m = -10$, $n = -20$, $z$ = ₹1440.

$\therefore$ Cost price of tape-recorder for Rajesh

$$= \left[\frac{100^2 z}{(100+m)(100+n)}\right]$$

$$= \left[\frac{100 \times 100 \times 1440}{(100-10)(100-20)}\right]$$

= ₹2000.

**27.** **(a)** Here, $m = -10$, $n = 20$, $z =$ ₹54000.

$\therefore$ Actual cost price of the scooter

$$= \left[\frac{100^2 z}{(100+m)(100+n)}\right]$$

$$= \left[\frac{100 \times 100 \times 54000}{(100-10)(100+20)}\right]$$

$$= \left(\frac{100 \times 100 \times 54000}{90 \times 120}\right) = ₹50000.$$

**28.** **(c)** We have, $m = 10$, $n = 20$.

$\therefore$ Resultant profit % $= \left(m + n + \frac{mn}{100}\right)$

$$= \left(10 + 20 + \frac{10 \times 20}{100}\right)$$

= 32%

**29.** **(b)** Here, $m = 20$, $n = -5$

$\therefore$ Resultant profit or loss % $= \left(m + n + \frac{mn}{100}\right)$

$$= \left(20 - 5 + \frac{20 \times -5}{100}\right) = 14\%$$

which represents profit as the sign is +ve.

**30.** **(c)** Here, $x = 5$.

$\therefore$ Overall loss% $= \left(\frac{x}{10}\right)^2 \% = \left(\frac{5}{10}\right)^2 \% = \frac{1}{4}\%$

**31.** **(c)** Here, $x = 20$

$\therefore$ Overall loss % $= \left(\frac{x}{10}\right)^2 \% = \left(\frac{20}{10}\right)^2 \% = 4\%$

**32.** **(a)** Here $x = 25$ and $y = -20$.

$\therefore$ Overall gain/loss%

$$= \left[\frac{100(x+y) + 2xy}{(100+x)+(100+y)}\right]\%$$

$$= \left[\frac{100(25-20) + 2 \times 25 \times -20}{(100+25)+(100-20)}\right]\%$$

$$= -\frac{100}{41}\% \text{ or } -2\frac{18}{41}\%$$

which represents loss being a –ve expression.

**33.** **(c)** Here, $x = 20$ and $y = 40$.

$\therefore$ Overall gain %

$$= \left[\frac{100(x+y) + 2xy}{(100+x)+(100+y)}\right]\%$$

$$= \left[\frac{100(20+40) + 2 \times 20 \times 40}{(100+20)+(100+40)}\right]\%$$

$$= \frac{7600}{260}\% = 29\frac{3}{13}\%$$

**34.** **(b)** We have, $x = -20$ and $y = -10$.

$\therefore$ Overall gain/loss

$$= \left[\frac{100(-20-10) + 2 \times -20 \times -10}{(100-20)+(100-10)}\right]\%$$

$$= -\frac{2600}{170}\%$$

$$= -15\frac{5}{17}\%$$

which represents loss being a negative expression.

**35.** **(a)** We have, $x = 20$ and $y = 25$.

$\therefore$ Overall gain % $= \left[\frac{y+x}{100-y} \times 100\right]\%$

$$= \left[\frac{25+20}{100-25} \times 100\right]\% = 60\%$$

**36.** **(c)** Here, $x = -10$ and $y = 20$.

$\therefore$ Overall gain/loss% $= \left[\frac{y+x}{100-y} \times 100\right]\%$

$$= \left[\frac{20-10}{100-20} \times 100\right]\%$$

$$= 12\frac{1}{2}\%$$

which represents gain being a positive expression.

**37.** **(c)** Here, $x = -10$ and $g = 15$.

Let, the inaccurate scale length $= y$ cm.

Using the formula, $\frac{100+g}{100+x} = \frac{\text{Correct measure}}{\text{Incorrect measure}}$

we get, $\frac{100+15}{100-10} = \frac{100}{y} \Rightarrow y = \frac{100 \times 90}{115} = 78.25$ cm.

$\therefore$ Actual length of the scale is 78.25 cm instead of 1 m.

**38.** **(a)** True measure = 100 cm.

False measure = 80 cm. Also, $x = 0$.

$\therefore$ Overall gain% is given by

$$\frac{100+g}{100+x} = \frac{\text{True measure}}{\text{False measure}}$$

$$\Rightarrow \frac{100+g}{100} = \frac{100}{80} \Rightarrow 100 + g = \frac{100 \times 100}{80}$$

$$\Rightarrow g = \frac{1000}{8} - 100 = 25\%$$

**39.** **(c)** Cost price of the CD sold at a loss of 22%

$$= \frac{A(100 + \%\text{gain})}{(100 - \%\text{loss}) + (100 + \%\text{gain})}$$

$= \dfrac{380(100+12)}{(100-22)+(100+12)} = \dfrac{380\times 112}{78+112}$

= ₹224.

Cost price of the CD sold at a gain of 12%

$= \dfrac{A(100-\%\text{loss})}{(100-\%\text{loss})+(100+\%\text{gain})}$

$= \dfrac{380(100-22)}{(100-22)+(100+12)} = \dfrac{380\times 78}{78+112}$

= ₹156.

**40. (a)** Marked price of the article = ₹65.

Selling price of the article = ₹56.16.

∴ Discount = 65 − 56.16 = ₹8.84.

∴ Discount % = $\dfrac{8.84\times 100}{65}$ = 13.6%

The first discount in the offered discount series is 10%

Let, the second discount of the series be $m$%.

∴ Single discount % = $\left(m+n-\dfrac{mn}{100}\right)\%$

or, $13.6\% = \left(m+10-\dfrac{10m}{100}\right)\%$

or, $13.6 = m + 10 - \dfrac{m}{10}$

or, $136 = 100 + 10m - m$ or, $9m = 36$

or, $m = 4\%$

**41. (b)** A single discount equivalent to three given successive discounts of 20%, 15% and 5% is given by

$=\left(20+15+5-\dfrac{(20\times 15+5\times 15+5\times 20)}{100}+\dfrac{20\times 15\times 5}{100^2}\right)\%$

that is, (40 − 4.75 + 0.15)% = 35.4%

Marked price of 250 chairs = 250 × 50 = ₹12500.

∴ Cash payment = $12500 - 12500 \times \dfrac{35.4}{100}$

= ₹8075.

**42. (a)** Using the formula

C.P. = $\left[\dfrac{100^2 z}{(100-d)\,(100+p)}\right]$,

the cost price of each taper-ecorder is given by

C.P. = $\left[\dfrac{100\times 100\times 1134}{(100-19)\,(100+40)}\right]$

$= \dfrac{100\times 100\times 1134}{81\times 140}$ = ₹1000.

## EXERCISE-2
## (BASED ON MEMORY)

**1. (c)** Cost price = ₹ $\dfrac{536+426}{2}$ = ₹481

**2. (b)** Let, the M.P. be ₹$x$,

∴ S.P. = $x$ − 10% of $x$ $= \dfrac{9x}{10}$

Gain = 25%

C.P. = ₹900

∴ 900 + 25% of 900 $= \dfrac{9x}{10}$

∴ $9x = 11250$ ∴ $x = 1250$

**3. (d)** 5% of the C.P. = ₹50

∴ C.P. of the table $= \dfrac{50\times 100}{5}$ = ₹1000

**4. (c)** S.P. = ₹45000

Loss = 10%

∴ C.P. $= \dfrac{45000\times 100}{100-10} = 50000$

If profit = 15%, then

S.P. = 50000 + 15% of 50000

= 50000 + 7500 = ₹57500

**5. (c)** C.P. of a pencil $= \dfrac{4}{6} = ₹\dfrac{2}{3}$

S.P. of a pencil $= \dfrac{6}{4} = ₹\dfrac{3}{2}$

∴ Gain $= \dfrac{3}{2} - \dfrac{2}{3} = \dfrac{5}{6}$

Gain % $= \dfrac{\frac{5}{6}}{\frac{2}{3}}\times 100 = \dfrac{5}{6}\times\dfrac{3}{2}\times 100 = 125$

**6. (c)** S.P. = ₹178

Loss = 11%

C.P. $= \dfrac{78\times 100}{100-11} = \dfrac{178\times 100}{89}$ ₹200

If profit is 11%, then

S.P. = 200 + 11% = ₹220

**7. (d) Set I:**

S.P. = ₹7400, Gain = 10%

C.P. $= \dfrac{7400\times 100}{110} = ₹\dfrac{74000}{11}$

**Set II:**

S.P. = ₹7400, Loss 10%

C.P. $= \dfrac{7400\times 100}{100-10} = ₹\dfrac{74000}{9}$

∴ C.P. of both the sets $= \dfrac{74000}{11} + \dfrac{74000}{9}$

$= \frac{20 \times 74000}{99} = \frac{1480000}{99}$

S.P. of both the sets = ₹14800

$\therefore$ Loss $= \frac{1480000}{99} - 14800 = \frac{14800}{99}$

$\Rightarrow$ Loss % $= \frac{\frac{14800}{99}}{\frac{1480000}{99}} \times 100 = 1$

**8.** **(c)** Profit on each 20 Kg of $a$ and $c$

= 20(38 − 34.5) + 20(36 − 32.4) = 70 + 72

= ₹142

Profit on 30 Kg of $a$ and 40 Kg of $b$

= 30 × (37 − 34.5) + 40( 33 − 28.6)

= ₹251

Profit on 20 Kg of $b$ and 40 Kg of $c$

= 20(40 − 28.6) + 40(38 − 32.4) = 228 + 224

= ₹452

Profit on 25 Kg of $c$ and 30 Kg of $a$

= 25(42 − 32.4) + 30(38 − 34.5) = 240 + 105

= ₹345

Profit on 40 Kg of $b$ and 20 Kg of $a$

= 40(37 − 28.6) + 20(40 − 34.5) = 336 + 110

= ₹446

Hence, he will earn maximum in bargain **(c)**.

**9.** **(a)** Here, $625 - x = 435 + x$ or, $2x = 625 - 435$

$\therefore \quad x = \frac{190}{2} = 95$

Hence, the cost price of the article

= 435 + 95 = ₹530

**10.** **(b)** Cost price $= 460\left(\frac{100}{115}\right) =$₹400

Required selling price $= 400\left(\frac{120}{100}\right) =$₹480

**11.** **(d)** Required cost price $= \frac{5765 + 4315}{2}$

$= \frac{10080}{2}$ = ₹5040

**12.** **(b)** Let, the cost of 1 metre of cloth be ₹$x$

$\therefore \quad (x + 10) \times 145 = 12325$

$\therefore \quad 145x + 1450 = 12325$

$\therefore \quad x = \frac{12325 - 1450}{145}$ = ₹75

**13.** **(e)** Cost price = ₹ $\frac{522 + 378}{2}$ = ₹450

**14.** **(c)** Let, the S.P. of the article be ₹100

$\therefore$ Profit = ₹26

$\therefore$ Cost price of the article = 100 − 26 = ₹74

$\therefore$ Required percentage $= \frac{34 \times 74}{100}$ = 25.16%

**15.** **(b)** Ratio of investment = 6:3:2

$\therefore$ Share of Mr. Shastri $= \frac{3}{11} \times 19800$

= ₹5400

**16.** **(c)** C.P. = 20 × 15 + 30 × 13 = ₹690

$\therefore$ S.P. $= \frac{4}{3}$ of $690 \times \frac{1}{50}$ = ₹18.40.

**17.** (a) Let, the cost price of the article be ₹$x$

Then, $2(84 - x) = 96 - x$

or, $168 - 2x = 96 - x$

$\therefore \quad x$ = ₹72.

**19.** **(c)** Giving no discount to customer implies selling the product on printed price. Suppose the cost price of the article is ₹100

Then, printed price $= \frac{100 \times (100 + 23.5)}{(100 - 5)}$

$= \frac{100 \times 247}{190}$

= ₹130.

**20.** **(e)** If no price given, selling price of T.V.

$= 17940 \times \frac{100}{92}$

= ₹19500

Cost price of T.V. $= 17940 \times \frac{100}{119.60}$

= ₹15000

Gain % $= \frac{19500 - 15000}{15000} \times 100$

= 30%

**21.** **(d)** S.P. of both the watches = ₹480

S.P. of each watch = ₹240

Gain = 20%

$\therefore$ C.P. $= \frac{240 \times 100}{100 + 20} = 200$

If loss = 20%, then C.P. $= \frac{240 \times 100}{100 - 20} = 300$

$\therefore$ C.P. of both the watches = ₹500

$\therefore$ Loss % $= \frac{20}{500} \times 100 = 4.$

**22.** **(b)** Suppose S.P. of each recorder = ₹$K$

If Gain = 10%, then

C.P. $= \frac{K \times 100}{100 + 10} = \frac{100K}{110} = \frac{10K}{11}$

If loss = 10%, then

C.P. $= \frac{K \times 100}{100 - 10} = \frac{100K}{90} = \frac{10K}{9}$

$\therefore$ C.P. of both the taperecorders

$= \frac{10K}{11} + \frac{10K}{9} = \frac{200K}{99}$

S.P. of both the taperecorders = $2K$

$\therefore$ Loss % = $\frac{2K}{200K} \times 100 = 1.$

**24.** **(b)** Let, S.P. of remaining 10 sheep = $K$ each

$\therefore$ $40 \times 150 + 10K - 60 \times 120 = 800$

$\Rightarrow$ $K = 200.$

**25.** **(c)** Suppose C.P. = ₹$K$

Marked price = ₹77

$\therefore$ S.P. = 77 − 10% = 69.30

$\therefore$ $69.30 - K$ = 10% of $K$

$\Rightarrow$ $11K = 693$

$\Rightarrow$ $1K = 63.$

**27.** **(d)** Suppose C.P. of 1000 gm = ₹1000

S.P. of 800 gm = ₹1000

$\therefore$ S.P. of 1000 gm = $\frac{1000}{800} \times 1000$ = ₹1250

$\therefore$ Profit % = $\frac{250}{1000} \times 100 = 25\%$

**28.** **(c)** S.P. = $\frac{4}{3}$ C.P.

Gain = $\frac{1}{3}$ C.P. = $\frac{100}{3}$ % of C.P.

$\therefore$ Gain % = $33\frac{1}{3}$

**29.** **(a)** C.P. = $26 \times 20 + 30 \times 36 = 520 + 1080$
$= 1600$

S.P. = $56 \times 30 = 1680$

$\therefore$ Profit % = 5

**30.** **(c)** Let, S.P. of 20 tables = ₹20

$\therefore$ C.P. of 15 tables = ₹20

$\therefore$ C.P. of 20 tables = $\frac{20}{15} \times 20 = \frac{80}{3}$

$\therefore$ Loss % = $\frac{\frac{80}{3} - 20}{\frac{80}{3}} \times 100 = 25.$

**32.** **(a)** S.P. = ₹700, Loss = 20%

$\therefore$ C.P. = $\frac{\text{S.P.} \times 100}{100 - \text{loss\%}} = \frac{700 \times 100}{80} = 875$

If gain is 20%, then

S.P.= 875 + 20% of 875

= 875 + 175 = ₹1050

**33.** **(b)** C.P. of 7 pencils = ₹9

C.P. of 1 pencil = ₹$\frac{9}{7}$

S.P. of 8 pencils = ₹11

S.P. of 1 pencil = ₹$\frac{11}{8}$

$\therefore$ Gain on 1 pencil = $\frac{11}{8} - \frac{9}{7} = \frac{77 - 72}{56} = \frac{5}{56}$

If gain is ₹10, then number of pencils purchased

$= \frac{56}{5} \times 10 = 112.$

**34.** **(c)** Let, C.P. of 16 articles = ₹16

S.P. of 12 articles = ₹16

$\therefore$ S.P. of 16 articles = $\frac{16}{12} \times 16$ = ₹$\frac{256}{12}$ = ₹$\frac{64}{3}$

$\therefore$ Gain on ₹16 = $\frac{64}{3} - 16 = \frac{16}{3}$

Gain % = $\frac{\frac{16}{3}}{16} \times 100 = 33\frac{1}{3}.$

**35.** **(c)** Suppose marked price = ₹$K$

$\therefore$ $K$ − 12.5% of $K$ = 140 + 20% of 140

$\Rightarrow$ 87.5% of $K$ = 140 + 28 = 168

$\therefore$ $K = \frac{16800}{87.50} = 192.$

**36.** **(c)** S.P. = ₹880, Loss = 20%

$\therefore$ C.P. = $\frac{\text{S.P.} \times 100}{100 - \text{Loss\%}}$

$= \frac{880 \times 100}{80} = 1100$

If gain is to be 10%, then S.P. should be ₹1210.

**37.** **(c)** 50% of 15000 = 7500

30% of 15000= 4500

Balance = 10500

20% of 10500 = 2100

Balance = 8400

$\therefore$ Difference between a single discount of 50% and two successive discounts of 30% and 20% is ₹900.

**38.** **(c)** ₹2400 are divided in the ratio of 3:4:5 between X, Y and Z

$\therefore$ X's share = $\frac{3}{12} \times 2400$ = ₹600

Since his share has been diminished by ₹5, X got ₹605.

**39.** **(c)** Annual income of A and B are 4K and 3K, say

$\therefore$ $4K - 3L = 600$

$3K - 2L = 600$

$K = 600, L = 600$

$\therefore$ Difference in incomes of A and B

$= 4K - 3K = K = 600.$

**40.** **(b)** Let, C.P. of 4 toys = ₹$x$

$\therefore$ S.P. of 3 toys = ₹$x$ S.P of 4 toys = $\frac{4x}{3}$

Profit % = $\frac{x/3}{x} \times 100 = 33\frac{1}{3}.$

**41.** **(d)** Let, C.P. of the bicycle for A = ₹$x$

C.P. of B = $x$ + 20% of $x$ = $\frac{6x}{5}$

C.P. of C = $\frac{6x}{5}$ + 25% of $\frac{6x}{5}$ = $\frac{6x}{5}+\frac{6x}{20}=\frac{3}{2}x$

$\therefore\quad \frac{3}{2}x = 225 \quad\Rightarrow\quad x = 150.$

**42.** **(b)** Marked price of 36 pens = ₹36, say

$\therefore$ C.P. of 40 pens = ₹36

C.P. of 36 pens = ₹$\frac{36}{40}\times 36$ = ₹$\frac{9}{10}\times 36$

$= \frac{324}{10}=\frac{3240}{100}$

S.P. of 36 pens = ₹36 − 10% of 36

$= 36 - \frac{36}{100}=\frac{3564}{100}$

$\therefore$ Profit% = $\frac{3564-3240}{3240}\times 100 = 10.$

**43.** **(a)** Let, C.P. of a book = ₹$x$

$\therefore$ C.P. of 12 books = ₹$12x$

S.P. of 12 books = ₹1800

Profit = ₹$3x$

$\therefore\quad 15x = 1800 \Rightarrow x = 120.$

**45.** **(c)** Cost price of chair

$= 800\left(1-\frac{10}{100}\right)\left(1-\frac{15}{100}\right) = 800\times\frac{9}{10}\times\frac{17}{20}=$ ₹612

Total cost price after transportion = 612 + 28 = 640

$\therefore$ Gain % = $\frac{800-640}{640}\times 100 = \frac{160}{640}\times100 = 25\%$

**46.** **(d)** Loss percentage = $\frac{5-3}{5}\times 100 = \frac{2}{5}\times 100 = 40\%$

**47.** **(c)** New S.P. = $480\times\frac{100}{80}\times\frac{120}{100}$ = ₹720.

**48.** **(a)** X's gain = $\left(5-2-\frac{5\times2}{100}\right)\%$ of 1,50,000

= ₹4350.

**49.** **(c)** Suppose number of balloons purchased = 120

$\therefore$ C.P. of 120 balloons = ₹100

S.P. of 120 balloons = ₹144

$\therefore$ Profit = 44%

**50.** **(d)** S.P. of 2 books = ₹2.80

Over all percentage change

$= 20 + (-20) + \frac{20\times(-20)}{100} = -4$ = 4% loss

$\therefore$ C.P. = $\frac{2.80\times100}{100-4} = 2.92$

$\Rightarrow$ Loss = ₹0.12.

**51.** **(a)** Percentage profit or loss is given by

$= \frac{11\times11-10\times10}{10\times10}\times 100 = 21\%$

Since the sign is +ve, there is a gain of 21%

**52.** **(d)** (100 − 10)% of $x$ = 72

$\therefore$ 105% of $x$ = $\frac{72}{90}\times 105$ = ₹84.

**53.** **(a)** $\left(10+12\frac{1}{2}\right)\%$ of $x$ = 9

$\therefore$ 100% of $x$ = $\frac{9\times100}{22\cdot5}$ = ₹40.

**54.** **(a)** % profit = $\frac{120-(80+20)}{(80+20)}\times 100 = 20\%$

**55.** **(d)** % profit = $\frac{8-5}{5}\times 100 = 60\%$

**56.** **(a)** S.P. of two articles = ₹2 × 99 = ₹198

Overall % change

$= 10 + (-10) + \frac{10\times(-10)}{100} = -1$ = 1% loss.

**57.** **(b)** Gain per cent = $\frac{18-15}{15}\times 100 = 20\%$

**58.** **(b)** C.P. = $\frac{5200\times100}{100+30}=\frac{5200\times100}{130}$ = ₹4000

**60.** **(d)** S.P. = 3990, gain = 5%

$\therefore$ C.P. = $\frac{3990\times100}{100+5} = 3800$

S.P. = ₹3990, Loss = 5%

$\therefore$ C.P. = $\frac{3990\times100}{100-5} = 4200$

$\therefore$ Total C.P. = ₹8000

Total S.P. = ₹7980

$\therefore$ Loss % = $\frac{20\times100}{8000}=\frac{1}{4} = 0.25.$

**61.** **(c)** C.P. of 50 articles = ₹50, say

$\therefore$ S.P. of 40 articles = ₹50

$\therefore$ S.P. of 50 articles = ₹62.50

$\therefore$ Gain % = $\frac{12\cdot50}{50}\times 100 = 25.$

**62.** **(a)** C.P. of machine = 1200 + 200 = ₹1400

% profit = $\frac{1680-1400}{1400}\times 100 = 20\%$

**63.** **(a)** S.P. = $840\times\frac{110}{100}\times\frac{95}{100}$ = ₹877.80.

**64.** **(d)** C.P. of 1 orange = ₹3.50

S.P. of 1 orange = ₹4

% profit = $\frac{0.50}{3.50}\times 100 = 14\frac{2}{7}\%$

**65.** **(b)** % profit = $15 - 12 - \frac{15\times12}{100}$

$= 3 - 1.80 = 1.20 = 1\frac{1}{5}\%$

**66.** **(a)** Gain % = $\frac{1}{5} \times 100 = 20\%$

**67.** **(d)** % profit which Ramesh gets

$= -10 + 30 - \frac{10\times30}{100} = + 17\%$

**69.** **(b)** Let, the C.P. be ₹100.

Let, the S.P be ₹$x$, then

$\frac{100-x}{x}\times100 = 20$

$\Rightarrow$ $100(100 - x) = 20x$

$\Rightarrow$ $10,000 - 100x = 20x$

$\Rightarrow$ $10,000 = 20x + 100x$

$\Rightarrow$ $10,000 = 120x$

$\Rightarrow$ $\frac{10,000}{120} = x$

$\Rightarrow$ ₹$\frac{250}{3} = x$

Hence, required loss %

$= 100-\frac{250}{3} = \frac{50}{3} = 16\frac{2}{3}\%$

**70.** **(d)** S.P. of both the articles is same here. So, profit on one article is equal to the loss on the other. Let the loss % be $x$, then

$\Rightarrow$ $25 - x - \frac{25x}{100} = 0$

$\Rightarrow$ $\frac{2500-100x-25x}{100} = 0$

$\Rightarrow$ $\frac{2500-125x}{100} = 0$

$\Rightarrow$ $2500 - 125x = 0$

$\Rightarrow$ $-125x = -2500$

$\Rightarrow$ $x = \frac{-2500x}{-125}$

$\Rightarrow$ $x = 20$

**71.** **(c)** Let, the number of eggs bought by him be 15

Therefore,

C.P. of 15 eggs = ₹25

So, S.P. of 15 eggs = ₹36

Hence, gain = 36 − 25 = ₹11

Thus, 15 eggs = ₹11

$= \frac{15}{11}\times143 =$ ₹143

= 195 eggs

**72.** **(a)** Let, the marked price of article be ₹100.

Therefore,

C.P. of article = ₹64

So, S.P. of article = ₹88

Thus, profit % = $\frac{88-64}{64}\times100 = 37.5\%$

**73.** **(b)** Let, the C.P. of the article be ₹$x$.

Then,

$\frac{144-x}{x}\times100 = x$

$\Rightarrow$ $(144 - x) \times 100 = x^2$

$\Rightarrow$ $x^2 + 100x - 14400 = 0$

$\Rightarrow$ $x^2 + 180x + 80x - 14400 = 0$

$\Rightarrow$ $x(x + 180) - 80(x + 180) = 0$

$\Rightarrow$ $(x - 80)(x + 180) = 0$

Therefore, $x$ = ₹80

**74.** **(b)** C.P. of the first article = $5000\times\frac{100}{125}$

= ₹4000

Then, loss on the second article

= ₹1000

Therefore, C.P. of the second article

= ₹6000.

Let, the loss per cent be $x\%$, then

$\frac{6000\times x}{100} = 1000$

$x = \frac{1000\times100}{6000}$

$= \frac{50}{3} = 16\frac{2}{3}\%$

**75.** **(a)** Let, the man buy (LCM of 8 and 12) oranges

Therefore,

C.P. of 24 oranges = $\frac{34}{8}\times24$

= 34 × 3 = ₹102

S.P. of 24 oranges = $\frac{57}{12}\times21$

= 57 × 2 = ₹114

Gain = ₹114 − ₹102

Gain = ₹12

Thus, ₹12 = 24 oranges.

Hence, ₹45 = $\frac{24}{12}\times45$ = 90 oranges.

**76.** **(d)** Let, the advertised price be ₹$x$

Then, S.P. = ₹$\frac{77x}{100}$

Therefore, C.P. = ₹$\left(\frac{77x}{100}-56\right)$

$\therefore$ $\frac{77x-5600}{100} = \frac{110}{100} = \frac{77x}{100}$

$\Rightarrow \quad \frac{77x - 5600}{100} = \frac{77x}{110} = \frac{7x}{10}$

$\Rightarrow \quad 77x - 5600 = 70x$

$\Rightarrow \quad 77x - 70x = 5600$

$\Rightarrow \quad 7x = 5600$

$\Rightarrow \quad x = \frac{5600}{7} = ₹800$

**77.** **(a)** Let, the printed price be ₹100

Selling price = ₹90

Cost price $= \frac{100}{112} \times 90$

Required ratio $= \frac{100 \times 90}{112} \times \frac{1}{100}$

$= \frac{45}{56} = 45:56$

**78.** **(d)** C.P. of the article $= \frac{170 \times 100}{85}$ = ₹200.

$\therefore$ Required S.P. $= \frac{200 \times 120}{100}$

= ₹240.

**79.** **(d)** Cost price of the item = ₹9600

Selling price of the item, $= 9600 \times \frac{95}{100} \times \frac{105}{100}$

= ₹9576

Hence, required loss = 9600 − 9576

= ₹24

**80.** **(d)** C.P. of 80 ball pens $= 140 \times \frac{100}{70}$ = ₹200

For a gain of 30%, S.P. $= \frac{200 \times 130}{100}$ = ₹260

$\therefore$ ₹260 = 80 ball pens

$\therefore$ ₹104 $= \frac{80}{260} \times 104 = 32$ ball pens.

**81.** **(d)** Cost price = 5600

Selling price $= 5600 \times \frac{3}{4}$

= 4200

Loss = 5600 − 4200 = 1400

% loss $= \frac{1400}{5600} \times 100$ = 25%

**82.** **(c)** The cost price of an article

$= \frac{996 + 894}{2}$

$= \frac{1890}{2}$ = ₹945

**83.** **(b)** Total cost price = 11250 + 150 + 800

= ₹12200

Selling price $= 12200 \times \frac{115}{100}$

= ₹14030

**84.** **(d)** The shopkeeper sells 10 notebooks in a day, then in two weeks (i.e., 14 days) he sells = 14 × 10 = 140 notebooks

Commission earned $= 45 \times \frac{4}{10} \times 140$

= ₹252

Sells 6 pencil boxes in a day, then in two weeks he sells (i.e., 14 days) = 14 × 6

= 84 pencil boxes

Commission earned $= 80 \times \frac{20}{100} \times 84$ = ₹1344

Total commission earned = 252 + 1344 = ₹1596

**85.** **(d)** Cost price of 30 Kg wheat = 30 × 45 = ₹1350

Cost price of 30 Kg wheat + 25% profit = Selling Price

= 1350 × 1.25 = ₹1687.50

40% of 30 Kg wheat = 30 × 0.40 = 12 Kg

Selling price of 12 Kg wheat

= 12 × 50 = ₹600

Remaining 18 Kg wheat's selling price

= 1687.50 − 600

= ₹1087.50

$\therefore$ Selling price of 1 Kg wheat $= \frac{1087.50}{18} = 60.4$ kg.

**86.** **(c)** Let, the marked price and the cost price be ₹$x$ and ₹$y$, respectively.

Now, according to the question,

50% of $x$ = 90% of $y$

$\Rightarrow \quad \frac{x \times 50}{100} = \frac{y \times 90}{100}$

$\Rightarrow \quad y = \frac{x \times 50}{90} = ₹\frac{5}{9}x$

$= \frac{5}{9}$ of the marked price.

**87.** **(b)** Marked price = ₹(7710 + 1285) = ₹8995

Let, the discount be $x$%

Now, according to the question,

$x$% of 8995 = 1285

$\Rightarrow \quad \frac{8995 \times x}{8995} = 1285$

$\Rightarrow \quad x = \frac{1285 \times 100}{8995} = \frac{100}{7} = 14\frac{2}{7}\%$

**88.** **(a)** Let, the C.P. of cycle be ₹$x$.

Now, according to the question,

$$840\times\frac{90}{100}=\frac{x\times126}{100}$$

$$\Rightarrow \quad x\times126=840\times90$$

$$\Rightarrow \quad x=\frac{840\times90}{126}=₹600$$

**89.** **(d)** Let, the marked price of article be ₹$x$.

Now, according to the question,

$$\therefore \quad \text{C.P. of article}=₹\frac{2x}{5}$$

$$\text{S.P. of article}=\frac{x\times90}{100}=₹\frac{9x}{10}$$

$$\text{Gain}=\frac{9x}{10}-\frac{2x}{5}=\frac{9x-4x}{10}=\frac{5x}{10}=\frac{x}{2}$$

$$\therefore \quad \text{Gain per cent}=\frac{\text{Gain}\times100}{\text{C.P.}}$$

$$=\frac{\frac{x}{2}\times100}{\frac{2x}{5}}=\frac{5\times100}{4}=125\%$$

**90.** **(b)** First S.P. of article $=\dfrac{200\times90}{100}=₹180$

After decrease of 5%

$$\text{S.P.}=\frac{180\times95}{100}=₹171$$

**91.** **(c)** 20 items are broken out of 144 items.

$\therefore$ C.P. of 124 items.

$$=₹\left(\frac{144\times90}{100}\right)=₹129.60$$

Total S.P. = ₹(1.20 × 124) = ₹148.8

$\therefore$ Gain = ₹(148.80 − 129.60) = ₹19.20

$$\therefore \quad \text{Gain per cent}=\frac{19.20}{129.60}\times100=14.8\%$$

**92.** **(a)** Let, the C.P. of article be ₹$x$.

$$\text{Then,} \quad \text{S.P.}=₹\frac{120x}{100}=₹\frac{6x}{5}$$

$$\text{Gain}=\frac{6x}{5}-x=\frac{6x-5x}{5}=₹\frac{x}{5}$$

$$\therefore \quad \text{Gain per cent}=\frac{\text{Gain}}{\text{S.P.}}\times100$$

$$=\frac{\frac{x}{5}}{\frac{6x}{5}}\times100=\frac{50}{3}=16\frac{2}{3}\%$$

**93.** **(a)** C.P. of article

$$=\frac{100}{100-\text{loss per cent}}\times\text{S.P.}$$

$$=\frac{100}{100-15}\times102=₹120$$

On selling at ₹134.40, we have,

Gain = ₹(134.4 − 120) = ₹14.4

$\therefore$ Gain per cent

$$=\frac{14.4}{120}\times100=12\%$$

**94.** **(a)** Let, the C.P. of first toy be ₹$x$.

$\therefore$ C.P. of second toy = ₹$y$

Now, according to the question,

$$\frac{x\times112}{100}=504$$

$$\Rightarrow \quad x=\frac{504\times100}{112}=₹450$$

$$\text{Again,} \ y\times\frac{96}{100}=504$$

$$\Rightarrow \quad y=\frac{504\times100}{96}=₹525$$

Total C.P. = ₹(450 + 525) = ₹975

Total S.P. = ₹(2 × 504) = ₹1008

Gain = ₹(1008 − 975) = ₹33

$$\therefore \quad \text{Profit per cent}=\frac{33\times100}{975}=\frac{44}{13}=3\frac{5}{13}\%$$

**95.** **(d)** For A,

$$\text{C.P. of horse}=₹\left(4800\times\frac{100}{80}\right)=₹6000$$

For B,

$$\text{S.P.}=₹\left(\frac{6000\times115}{100}\right)=₹6900$$

B's profit = ₹(6900 − 4800) = ₹2100

**96.** **(d)** Let, the original price of the article be ₹$x$ per Kg.

$$\therefore \quad \text{New price}=₹\frac{79x}{100} \text{ per Kg}$$

Now, according to the question,

$$\frac{100}{\frac{79x}{100}}-\frac{100}{x}=3$$

$$\Rightarrow \quad \frac{10000}{79x}-\frac{100}{x}=3$$

$$\Rightarrow \quad \frac{10000-7900}{79x}=3$$

$$\Rightarrow \quad \frac{2100}{79x}=3$$

$$\Rightarrow \quad \frac{700}{79x}=1$$

$$\Rightarrow \quad 79x=700 \quad \Rightarrow \quad x=\frac{700}{79}$$

$$\therefore \quad \text{New price}=\frac{79x}{100}=\frac{79}{100}\times\frac{700}{79}=₹7 \text{ per Kg}$$

**97.** **(c)** Let, the C.P. of the article be ₹100.

$\therefore$ Marked price = ₹130

$$\Rightarrow \text{ Selling price} = \frac{130\times\left(100-\frac{25}{4}\right)}{100} = \frac{130\times 375}{400}$$

$$= ₹\frac{975}{8} = ₹\left(121\frac{7}{8}\right)$$

$$\therefore \text{ Gain\%} = \left(121\frac{7}{8}-100\right) = 21\frac{7}{8}\%$$

**98.** **(a)** C.P. of the chair $=\left(600-\frac{600\times 15}{100}\right)\times\frac{80}{100}$

$$= \frac{510\times 80}{100} = ₹408$$

Actual C.P. = ₹ (408 + 28) = ₹436

Gain per cent $=\frac{545-436}{436}\times 100 = 25\%$

**99.** **(a)** Single equivalent discount for 20% and 10%

$$= \left(20+10-\frac{20\times 10}{100}\right) = 28\%$$

Single equivalent discount for 28% and 10%

$$= \left(28+10-\frac{28\times 10}{100}\right) = 35.2\%$$

$\therefore$ S.P. of the piano $=\frac{15000\times(100-35.2)}{100} = ₹9720$

**100.** **(a)** S.P. of 25 m of cloth − C.P. of 25 m of cloth = S.P. of 5 m of cloth

$\therefore$ C.P. of 25 m of cloth = S.P. of 20 m of cloth

$\therefore$ C.P. = ₹20, S.P. = ₹25 (let)

$\therefore$ Gain per cent $=\frac{5}{20}\times 100 = 25\%$

**101.** **(c)** Let, the C.P. of the suitcase for A be ₹$x$.

Now, according to the question,

$$x\times\frac{110}{100}\times\frac{130}{100} = 2860$$

$$\Rightarrow x\frac{2860\times 100\times 100}{100\times 130} = ₹2000$$

**102.** **(b)** Total expected S.P. $=\frac{96000\times 110}{100} = ₹105600$

S.P. of the first part $=\frac{2}{5}\times 96000\times\frac{94}{100} = ₹36096$

S.P. of the remaining part = 105600 − 36096 = ₹69504

C.P. of the remaining part $=\frac{3}{5}\times 96000 = ₹57600$

Gain = ₹(69504 − 57600) = ₹11904

Let, the gain per cent be $x$.

Now, according to the question,

$$\frac{57600\times x}{100} = 11904$$

$$\Rightarrow x = \frac{11904\times 100}{57600} = 20\frac{2}{3}\%$$

**103.** **(c)** Let, the C.P. of the article be ₹$x$.

Now, according to the question,

$$\frac{120x}{100}-\frac{115x}{100} = 27 \Rightarrow \frac{5x}{100} = 27$$

$$\Rightarrow x = \frac{27\times 100}{5} = ₹540$$

**104.** **(d)** Let, the C.P. of a ball be ₹$x$.

$\therefore$ S.P. of 17 balls = ₹720

Now, according to the question,

$17x - 720 = 5x$

$\Rightarrow 12x = 720 \Leftrightarrow x = ₹60$

**105.** **(c)** Let, the C.P. of items A and B be ₹$x$ and ₹$y$, respectively.

Now, according to the question,

10% of $x$ = 15% of $y$

$$\Rightarrow \frac{x}{y} = \frac{15}{10} = \frac{3}{2} \Leftrightarrow x:y = 3:2$$

Clearly, the required C.P. of A and B will be ₹3000 and ₹2000, respectively.

Quicker Method:

$$10\% \text{ of } 3000 = \frac{3000\times 10}{100} = ₹300$$

$$15\% \text{ of } 2000 = \frac{2000\times 15}{100} = ₹300$$

**106.** **(b)** Quicker Method:

Net gain per cent $=\left(20-15-\frac{20\times 15}{100}\right)$

= 20 − 18 = 2%

**107.** **(a)** Quicker Method:

Single equivalent discount

$$= \left(20+10-\frac{20\times 10}{100}\right) = 28\%$$

$$\Rightarrow \text{ C.P. of table} = \frac{1500\times 72}{100} = ₹1080$$

Actual C.P. = ₹ (1080 + 20) = ₹1100

$\therefore$ Required S.P. = ₹$\left(1100\times\frac{120}{100}\right)$=₹1320

**108.** **(c)** Let, the C.P. for A be ₹ $x$.

Now, according to the question,

$$x\times\frac{120}{100}\times\frac{110}{100}\times\frac{225}{200} = 29.70$$

$$\Rightarrow x = \frac{29.70\times 100\times 100\times 200}{120\times 110\times 225} = 20$$

**109.** **(a)** C.P. for 80 ball pens $=140\times\dfrac{100}{70}=₹200$

For a gain of 30%

$$\text{S.P.}=\frac{200\times130}{100}=₹260$$

$\because$ ₹260 = 80 ball pens

$\therefore$ $₹104=\dfrac{80}{260}\times104=32$

**110.** **(a)** Let, the marked price of the trouser be ₹$x$.

According to the question,

$$\frac{x\times40}{100}=320$$

$$\Rightarrow x=\frac{320\times100}{40}=₹\ 800$$

$\therefore$ S.P. of trouser $=\dfrac{800\times60}{100}=₹480$

**111.** **(b)** Market price of the gift item $=\dfrac{510\times100}{85}$

$= ₹\ 600$

S.P. for Rahim $=\dfrac{600\times105}{100}=₹\ 630$

Earned profit = ₹ (630 − 510) = ₹ 120

**112.** **(c)** Total C.P. = ₹ 100 (100 articles)

Total S.P. $=75\times\dfrac{140}{100}+25\times\dfrac{60}{100}\times1.4$

= 105 + 21 = ₹ 126

$\therefore$ Gain per cent = 26

**113.** **(b)** Total C.P. $=\dfrac{240\times48}{12}=$ ₹960

S.P. for a gain of 25% $=\dfrac{960\times125}{100}=$ ₹1200

Amount received on half of bananas at₹5 per banana = 120 × 5 = ₹600

Remaining bananas $=120\times\dfrac{5}{6}=100$

S.P. of these 100 bananas = ₹600

$\therefore$ Rate = ₹6 per banana

**114.** **(d)** Ratio of profit =350000:140000 = 5:2

If the total profit be ₹$x$, then

A's share $=\dfrac{5}{7}\times\dfrac{4x}{5}+\dfrac{x}{5}=\dfrac{4x}{7}+\dfrac{x}{5}$

$$=\frac{20x+7x}{35}=₹\frac{27x}{35}$$

B's share $=\dfrac{2}{7}\times\dfrac{4x}{5}=₹\dfrac{8x}{35}$

$\therefore$ Difference $=\dfrac{27x}{35}-\dfrac{8x}{35}=\dfrac{19x}{35}$

Now, according to the question,

$$\therefore\ \frac{19x}{35}=38000$$

$$\therefore\ x=\frac{38000\times35}{19}=₹70000$$

**115.** **(a)** Let, the original marked price be ₹$x$.

Equivalent discount % $=\left(10+6-\dfrac{10\times6}{100}\right)\%$

= (16 − 0.6)% = 15.4%

Selling price $=x\left(\dfrac{100-15.4}{100}\right)=\dfrac{84.6x}{100}=\dfrac{846}{1000}$

Now, according to the question,

$$\frac{846x}{1000}=846$$

$$\therefore\ x=\frac{846\times1000}{846}=₹1000$$

**116.** **(c)** Let, C.P. of article = ₹100 and marked price = ₹$x$

Single equivalent discount

$$=\left(20+\frac{25}{4}-\frac{20\times25}{400}\right)\%=25\%$$

Now, according to the question,

$$x\times\frac{75}{100}=120$$

$$\Rightarrow\ x=\frac{120\times100}{75}=₹160$$

$\therefore$ The required percentage = (160 − 100) = 60%

**117.** **(a)** Single equivalent discount for 10% and 20%

$$=20+10-\frac{20\times10}{100}=28\%$$

Single equivalent discount for 28% and 40%

$$=40+28-\frac{40\times28}{100}=68-11.2=56.8\%$$

**118.** **(c)** Let, the marked price of TV be ₹$x$.

Now, according to the question,

$$\frac{4x}{5}-\frac{3x}{4}=500$$

$$\Rightarrow\ \frac{16x-15x}{20}=500\ \Rightarrow\ \frac{x}{20}=500$$

$\Rightarrow$ $x$ = 10000

$\therefore$ Required cost price $=₹\left(\dfrac{10000\times80}{100}\right)$

= ₹8000

**119.** **(c)** Let, the required cost price be ₹$x$, then by Rule of fraction, we have

$$x\times\frac{110}{10}\times\frac{120}{100}\times\frac{85}{100}=56100$$

$\Rightarrow \quad x \times \frac{11}{10} \times \frac{6}{5} \times \frac{17}{20} = 56100$

$\Rightarrow \quad x = \frac{56100 \times 10 \times 5 \times 20}{11 \times 6 \times 17} =$ ₹50000

**120.** **(a)** Let, the C.P. of article be ₹$x$

Now, according to the question,

$\frac{117x}{100} - \frac{81x}{100} = 162$

$\Rightarrow \quad \frac{36x}{100} = 162$

$\Rightarrow \quad x = \frac{162 \times 100}{36} =$ ₹450

**121.** **(d)** Required S.P. of 150 pens

$= 150 \times 12 \times \frac{115}{100} =$ ₹2070

S.P. of first 50 pens $= \frac{50 \times 12 \times 110}{100} =$ ₹660

C.P. of 100 pens = ₹1200

Let, the required gain % be $x$.

Now, according to the question,

$\frac{1200 \times (100 + x)}{100} + 660 = 2070$

$\Rightarrow \quad 1200 + 12x = 2070 - 660 = 1410$

$\therefore \quad x = \frac{1410 - 1200}{12} = \frac{210}{12} = \frac{35}{2} = 17\frac{1}{2}\%$

**122.** **(d) Quicker Method:**

Here, S.P. is same. Hence there is always a loss.

Loss per cent $= \frac{20 \times 20}{100} = 4\%$

**123.** **(b) Quicker Method:**

Gain per cent $= \frac{40 - 25}{25} \times 100 = \frac{15}{25} \times 100$

$= 60\%$

**124.** **(b)** Let, the C.P. of A be ₹$x$.

Now, according to the question,

$x \times \left(1 + \frac{1}{5}\right) \times \frac{120}{100} \times \left(1 - \frac{1}{6}\right) =$ ₹600

$\Rightarrow \quad x \times \frac{6}{5} \times \frac{6}{5} \times \frac{5}{6} = 600$

$\Rightarrow \quad x = \frac{600 \times 5}{6} =$ ₹500

**125.** **(d)** Let, the total amount be ₹$x$

Now, according to the question,

$\therefore \quad x - \frac{x}{5} - \frac{4x}{5} \times \frac{5}{100} - 120 = 1400$

$\Rightarrow \quad x - \frac{x}{5} - \frac{x}{25} = 1520$

$\Rightarrow \quad \frac{25x - 5x - x}{25} = 1520$

$\Rightarrow \quad \frac{19x}{25} = 1520$

$\Rightarrow \quad x = \frac{1520 \times 25}{19} =$ ₹2000

$\therefore$ Expenditure on transport

$= \frac{4x}{5} \times \frac{5}{100} = \frac{x}{25} = \frac{1}{25} \times 2000$

= ₹80

**126.** **(a)** Let, the cost price be ₹100 and the marked price be ₹$x$.

Now, according to the question,

$x \times \frac{3}{4} = 125$

$\Rightarrow \quad x = \frac{125 \times 4}{3} =$ ₹$\frac{500}{3}$

$\therefore$ required ratio $= \frac{500}{3} : 100 = 5:3$

**127.** **(b)** Quicker Method:

Single equivalent discount for two successive discounts of $x\%$ and $y\%$

$= \left(x + y - \frac{xy}{100}\right)\%$

$\therefore$ Single equivalent discount for 10% and 20%

$= \left(10 + 20 - \frac{10 \times 20}{100}\right)\% = 28\%$

Single equivalent discount for 28% and 50%

$= \left(50 + 28 - \frac{50 \times 28}{100}\right)\% = (78 - 14)\% = 64\%$

**128.** **(d)** I. Single equivalent discount

$= \left(10 + 10 - \frac{10 \times 10}{100}\right)\% = 19\%$

II. Single equivalent discount

$= \left(12 + 8 - \frac{12 \times 8}{100}\right)\%$

$= 19.04\%$

III. Single equivalent discount

$= \left(15 + 5 - \frac{15 \times 5}{100}\right)\% = 19.5\%$

**129.** **(b)** $A = P\left(1 - \frac{R}{100}\right)^T$

$\Rightarrow \quad 729 = P\left(1 - \frac{10}{100}\right)^3$

$\Rightarrow \quad 729 = P \times \left(\frac{9}{10}\right)^3 = \frac{729}{1000}P$

$\Rightarrow \quad P = \frac{729 \times 1000}{729} =$ ₹1000

**130.** **(a)** Let, the number of oranges bought be ₹$x$.

$\therefore$ C.P. of $x$ oranges $=\dfrac{x\times 40}{2\times 12}+\dfrac{x\times 40}{2\times 12}=₹\dfrac{70x}{24}$

$\therefore$ S.P. of $x$ oranges $=\dfrac{x\times 45}{12}$

Now, according to the question,

$$\frac{45x}{12}-\frac{70x}{12}=480$$

$$\Rightarrow \quad \frac{90x-70x}{24}=480$$

$$x=\frac{480\times 24}{20}=576=48\times 12=48 \text{ dozen}$$

**131.** **(d)** Let, the C.P. of chair sold at loss be ₹$x$

$\therefore$ C.P. second chair = ₹$(900 - x)$

Now, according to the question,

$$\frac{900-x}{4}-\frac{x}{5}=90$$

$$\Rightarrow \quad \frac{4500-5x-4x}{20}=90$$

$$\Rightarrow \quad 4500-9x=1800$$

$$\Rightarrow \quad x=\frac{2700}{9}=₹300$$

**132.** **(b)** Let, S.P. of 100 oranges be ₹$x$.

$\therefore$ S.P. of 20 oranges $=\dfrac{x\times 20}{100}=₹\dfrac{x}{5}=$ Gain

$$\therefore \quad CP=x-\frac{x}{5}=₹\frac{4x}{5}$$

$$\therefore \text{ Gain per cent}=\frac{\frac{x}{5}}{\frac{4x}{5}}\times 100=\frac{100}{4}=25\%$$

**133.** **(c)** Let, the C.P. of article be ₹100 and its S.P. be ₹$x$.

Now, according to the question,

$$100\times\frac{60}{100}=\frac{x\times 50}{100}$$

$$\Rightarrow \quad 60=\frac{x}{2} \quad \Rightarrow \quad x=120$$

$$\therefore \quad \text{Gain}\%=20\%$$

**134.** **(d)** C.P. of two horses = ₹(2 × 40000) = 80000 and S.P. of two horses = ₹(80000 − 3600) = 76400

S.P. of one horse $=₹\left(4000\times\dfrac{115}{100}\right)=46000$

S.P. of the other horse = ₹(76400 − 46000) = 30400

**135.** **(d)** Let, the seller buy $xy$ guavas.

$\therefore$ C.P. of $xy$ guavas $=xy\times\dfrac{y}{x}=y^2$

S.P. of $xy$ guavas $=xy\times\dfrac{x}{y}=x^2$

$\therefore$ Gain = $x^2 - y^2$ ($\because x>y$)

$$\text{Gain}\%=\frac{x^2-y^2}{y^2}\times 100$$

**136.** **(c)** Let, C.P. be ₹$x$, then

$$\text{S.P.}=x+\frac{15x}{100}=₹\frac{155x}{100}$$

If he had bought the horse for 25% less, then

$$\text{C.P.}=x-\frac{25x}{100}=₹\frac{75x}{100}$$

Now, according to the question,

$$\frac{155x}{100}-60=\frac{75x}{100}\times\left(1+\frac{32}{100}\right)=\left[\frac{75}{100}\times\frac{132}{100}\right]x$$

$$\Rightarrow \quad \frac{115x}{100}-60=\frac{99x}{100} \quad \Rightarrow \quad \frac{155x}{100}-\frac{99x}{100}=60$$

$$\Rightarrow \quad \frac{16x}{100}=60 \quad \therefore \; x=\frac{6000}{16}=₹375$$

**137.** **(a)** Let, A buy the article in ₹100.

According to the question,

B's cost = ₹125

$$\text{C's cost}=₹125\left(\frac{100+20}{100}\right)=₹150$$

$$\text{D's cost}=₹150\left(\frac{100+10}{100}\right)=₹165$$

Here, at the end the article was sold out at ₹ 165.

$\therefore$ Required cost for $\text{A}=\dfrac{330}{165}\times 100=₹200$.

**138.** **(a)** Let, the cost of article be ₹$x$. At $x\%$ loss, the article sold at ₹21

Now, according to the question,

$$x\left(\frac{100-x}{100}\right)=21 \quad \Rightarrow \quad x\left(1-\frac{x}{100}\right)=21$$

$$\Rightarrow \quad x-\frac{x^2}{100}=21 \quad \Rightarrow \quad x^2-100x+2100=0$$

$$\Rightarrow \quad (x-30)(x-70)=0$$

$\therefore$ $x$ = ₹30 or, ₹70

**139.** **(c)** Here, 50 articles were sold at a profit of 20% and 50 articles at a profit of 40%

Let, the price of each article be ₹$x$, then Total S.P.

$$=\left\{\frac{50x\times 20}{100}+50x\right\}+\left\{\frac{50x\times 40}{100}+50x\right\}$$

= ₹$130x$

Selling Price of all the articles at 25% profit

$$=100x+\frac{100x-25}{100}=125x$$

Difference = $130x - 125x = 5x$

$\Rightarrow$ $5x$ = ₹100 $\Rightarrow$ $x$ = ₹20

$\therefore$ The cost price of each article was ₹20

**140.** **(c)** Let, the second successive discount be *x%*

Now, according to the question,

$$3200\left(1-\frac{10}{100}\right)\left(1-\frac{x}{100}\right)=2448$$

$$\Rightarrow \quad 3200\times\frac{90}{100}\times\left(1-\frac{x}{100}\right)=2448$$

$$\Rightarrow \quad 1-\frac{x}{100}=\frac{2448}{2880}$$

$$\Rightarrow \quad \frac{x}{100}=1-\frac{2448}{2880}=\frac{432}{2880}=\frac{3}{20}$$

$$\therefore \quad x=\frac{300}{20}=15\%$$

∴ The rate of second discount is 15%

**141.** **(a)** Let, C.P. be ₹100

Marked price $=100\times\frac{30}{100}+100=₹130$

Price after 15% discount $=130-\frac{130\times15}{100}$

= 130 − 19.5 = ₹110.5

∴ profit = ₹10.5

∵ ₹10.5 profit, then C.P. = ₹100

∴ ₹84 profit, then $\text{C.P.}=\frac{84}{10.5}\times100=₹800$

**142.** **(b)** Let, the marked price be ₹*x*.

Selling price of the article at 5% commission

$$=x\left(\frac{100-5}{100}\right)=₹\frac{95x}{100}$$

Cost price of the article at 10% profit

$$=\frac{95x}{100}\left(\frac{100}{100+10}\right)=₹\frac{95x}{110}$$

Now, according to the question,

$$\frac{95x}{110}=95$$

$$\Rightarrow \quad x=\frac{95\times110}{95}=₹110$$

**143.** **(a)** Let, the cost price of 1 Kg (1000g) of sugar be ₹*x*

∴ Cost price of 950g of sugar $=₹\frac{950x}{1000}$

Now, according to the question,

Selling price of 950g of sugar = ₹*x*

$$\therefore \quad \text{Profit \%}=\left(\frac{x-\frac{950x}{1000}}{\frac{950x}{1000}}\right)\times100$$

$$=\frac{x(1000-950)}{950x}\times100$$

$$=\frac{1000-950}{950}\times100=\frac{5\times100}{95}=\frac{100}{19}=5\frac{1}{5}\%$$

Quicker Method:

Profit per cent $=\frac{1000-950}{950}\times100\%$

$$=\frac{50}{950}\times100\%=\frac{100}{19}\%=5\frac{5}{19}\%$$

**144.** **(c)** Let, the price of horse be ₹*x*

∴ Price of carriage = ₹(20000 − *x*)

Now, according to the question,

$$\frac{x\times120}{100}+\frac{(20000-x)\times90}{100}=20000\left(1+\frac{2}{100}\right)$$

$$\Rightarrow \frac{120x}{100}+\frac{20000\times90-90x}{100}=20400$$

⇒ 1.2*x* + 18000 − 0.9*x*= 20400

⇒ 0.3*x* = 2400 ⇒ *x* = 8000

⇒ Cost price of horse = ₹8000

**145.** **(a)** Let, the price of article be ₹100

A sold to B at = ₹115

C purchased from B for $=₹\left[115-\frac{115\times10}{100}\right]$

= ₹103.50

Required C.P. for $A=₹\frac{517.50}{103.50}\times100=₹500$

**146.** **(c)** Let, the selling price of article be ₹*x*[Here, 10% loss on selling article at $\frac{2x}{3}$ price.]

Let, C.P. = y

Then, after 10%loss the selling price $=\frac{90y}{100}$

$$\therefore \quad \frac{90y}{100}=\frac{2}{3}x$$

$$\Rightarrow y=\frac{20}{27}x$$

$$\therefore \quad \text{C.P.}=\frac{20}{27}x$$

∴ The gain per cent on selling it at the original price

$$=\frac{x-\frac{20}{27}x}{\frac{20}{27}x}\times100\%$$

$$=\frac{\frac{7x}{27}}{\frac{20x}{27}}\times100\%=35\%$$

**147.** **(c)** Let, the cost price be ₹*x*

Price after 10% loss $=₹\frac{90x}{100}$

Now, according to the question,

$\frac{90x}{100} = 45000$

$\therefore \quad x = ₹50000$

C.P. given by C = Given a profit of 10% to

$A = \frac{110}{100} \times 50000 = ₹55000$

$\therefore$ B bought it in ₹45000 and sold it in ₹55000.

$\therefore$ Required profit $= \frac{55000 - 45000}{45000} \times 100\%$

$$= \frac{200}{9}\%$$

**148.** **(c)** Let, the marked price be ₹100

$\therefore$ Cost price = ₹80 S.P. after giving 12% discount at ₹100= ₹88

$\therefore$ Profit $= \frac{88-80}{80} \times 100\% = \frac{8}{80} \times 100\% = 10\%$

**149.** **(b)** Let, the list price of wrist watch be ₹$x$.

Selling price of wrist watch at 10% discount

$$= ₹\, x\left(\frac{100-10}{100}\right) = ₹\frac{9x}{10}$$

Cost price of wrist watch at 20% profit

$$= ₹\frac{9x}{10}\left(\frac{100}{100+20}\right) = ₹\left(\frac{9x}{10} \times \frac{10}{12}\right) = ₹\frac{3x}{4}$$

Now, according to the question,

$$\frac{3x}{4} = 450 \Rightarrow x = \frac{450 \times 4}{3} = 600$$

$\therefore$ List price of the wrist watch = ₹600

**150.** **(c)** Amount received by C

$= \text{Total profit} \times \left(1 - \frac{1}{3} - \frac{1}{4}\right)$

$= \text{Total profit} \times \frac{5}{12}$

Now, according to the question,

$\Rightarrow 5000 = \frac{5}{12} \times \text{Total profit}$

$\Rightarrow$ Total profit = ₹12000

$\therefore$ The amount received by A

$$= \frac{12000}{3} = ₹4000$$

**151.** **(a)** Let, the number of cakes be 100.

Let, each cake's cost price be ₹100.

Then, total cost price= ₹(100× 100)=₹10000

Now, market price of each cake $= \frac{100 \times 140}{100} = ₹140$

Now, selling price of 24 cakes $= 24 \times \frac{100 \times 80}{100} = ₹1920$

And selling price of 60 cakes = 60 × 140 =₹8400

$\therefore$ Total selling price = 8400+ 1920 = ₹10320

Profit= 10320 − 10000=320

$\therefore$ Required % profit $= \frac{320}{10000} \times 100 = 3.2\%$

**152.** **(a)** Loss percentage $= \left(\frac{\text{Common gain or loss}}{10}\right)^2$

$$= \frac{144}{100} = \frac{36}{25} = 1\frac{11}{25}\%$$

**Quicker Method:**

$12 - 12 - \frac{12 \times 12}{100} = -\frac{144}{100} = -\frac{36}{25} = -1\frac{11}{25}\%$

Negative sign shows loss.

**153.** **(a)** Cost price = ₹78350

Marked price $= 78350 \times \frac{130}{100} = ₹101855$

Selling price $= 101855 \times \frac{80}{100} = ₹81484$

Profit = 81484 − 78350 = 3134

$\therefore$ Required % profit $= \frac{3134}{78350} \times 100 = 4\%$

**154.** **(d)** Amount received by all the officers

$= 45 \times 25000 = 11,25,000$

Amount received by each clerk $= \frac{3}{5} \times 25000 = 15000$

Amount received by all the clerks

$= 80 \times 15000 = 12,00,000$

Total amount of profit earned = 11,25,000 + 12,00,000 = 23.25 Lakhs.

**155.** **(e)** Let, the cost price of the articles be ₹100.

To earn a profit of 30% he labelled them ₹130.

After giving a discount of 10% the selling price of the articles = 0.9 × 130 = 117

So, actual profit per cent $= \frac{(117-100)}{100} \times 100 = 17\%$

**156.** **(a)** First S.P. $= \frac{46000 \times 88}{100} = ₹40480$

Second S.P. $= \frac{40480 \times 112}{100} = ₹45337.6$

$\therefore$ Loss = ₹(46000 −45337.6)=₹662.4

**157.** **(d)** First selling price $= \frac{54000 \times 92}{100} = ₹49680$

Second selling price $= 49680 \times \frac{110}{100} = ₹54648$

$\therefore$ Profit = 54648 − 54000 = ₹648

**158.** **(e)** Total number of notebooks sold in two weeks $= 2 \times 7 \times 10 = 140$.

Total commission earned on selling of notebooks

$$=140\times457\times\frac{4}{100}=₹2559.2$$

Similarly, commission earned on selling of pencils

$$=2\times7\times6\times80\times\frac{20}{100}₹1344$$

Total commission earned = 2559.2 + 1344 =₹3903.2 ≈ 3900

**159.** **(b)** Required profit per cent

$$=\frac{348000-25000}{250000}\times100=\frac{98000}{250000}\times100=39.2\%$$

**160.** **(d)** C.P. of wheat = 30 × 45 = ₹1350

40% of 30 Kg = 12 Kg

S.P. of 12 Kg = 12 × 50 = ₹600

For 25% profit, total S.P. of all the wheat is

$$1350\times\frac{125}{100}=1350\times\frac{5}{4}=₹\frac{6750}{4}=₹1687.5$$

Remaining wheat (30 − 12) = 18 Kg

$$\text{Rate of the remaining wheat}=\frac{1087.5}{18}\approx₹60$$

**161.** **(d)** $\frac{4080+3650}{2}=3865$

# Time and Work, Work and Wages

# 10

## INTRODUCTION

In our everyday life, we come across many situations demanding timely completion of work assignments. We complete those earlier or later based on the needs. Accordingly, manpower is increased or decreased. To explain, the time allowed and the manpower engaged, for a certain work, are inversely proportional to each other, that is, more the number of manpower involved, lesser is the time required to complete a work. We also come across situations where 'time and work' or 'men and work' are directly proportional to each other.

For solving problems on 'time and work', the following general rules are adhered:

1. If 'A' can do a piece of work in $n$ days, then at a uniform rate of working 'A' will finish $\frac{1}{n}$ work in one day.
2. If $\frac{1}{n}$ of a work is done by 'A' in one day, then 'A' will take $n$ days to complete the full work.
3. If 'A' does $\frac{1}{n}$ of a work in 1 hour, then to complete the full work, 'A' will take $\frac{n}{m}$ hours.
4. If 'A' does three times faster work than 'B', then ratio of work done by A and B is 3:1 and ratio of time taken by A and B is 1:3.
5. A, B and C can do a piece of work in $T_1$, $T_2$ and $T_3$ days, respectively. If they have worked for $D_1$, $D_2$ and $D_3$ days respectively, then

   Amount of work done by A = $\frac{D_1}{T_1}$

   Amount of work done by B = $\frac{D_2}{T_2}$

   Amount of work done by C = $\frac{D_3}{T_3}$

   Also, the amount of work done by A, B and C, together

   $$= \frac{D_1}{T_1} + \frac{D_2}{T_2} + \frac{D_3}{T_3}.$$

   which will be equal to 1, if the work is complete.

## SOME BASIC FORMULAE

1. If A can do a piece of work in $X$ days and B can do the same work in $Y$ days, then both of them working together will do the same work in $\frac{XY}{X+Y}$ days.

**Explanation:**

A's 1 day's work = $\frac{1}{X}$.

B's 1 day's work = $\frac{1}{Y}$.

Then, (A + B)'s 1 day's work = $\frac{1}{X} + \frac{1}{Y} = \frac{X+Y}{XY}$.

$\therefore$ A and B together can complete the work in $= \frac{XY}{X+Y}$ days.

**Illustration 1:** A can finish a piece of work by working alone in 6 days; B, while working alone, can finish the same work in 12 days. If both of them work together, then in how many days, the work will be completed?

**Solution:** Here, $X = 6$ and $Y = 12$.

$\therefore$ By working together, A and B will complete the work in $= \dfrac{XY}{X+Y}$ days $= \dfrac{6 \times 12}{6+12}$ days, i.e., 4 days.

2. If A, B and C, while working alone, can complete a work in $X$, $Y$ and $Z$ days, then they will together complete the work in $\dfrac{XYZ}{XY + YZ + ZX}$ days.

**Explanation:**

A's 1 day's work $= \dfrac{1}{X}$.

B's 1 day's work $= \dfrac{1}{Y}$.

C's 1 day's work $= \dfrac{1}{Z}$.

$\therefore$ (A + B + C)'s 1 day's work

$$= \frac{1}{X} + \frac{1}{Y} + \frac{1}{Z} = \frac{XY + YZ + ZX}{XYZ}.$$

So, A, B and C together can complete the work in

$$= \left(\frac{XYZ}{XY + YZ + ZX}\right) \text{days.}$$

**Illustration 2:** A, B and C can complete a piece of work in 10, 15 and 18 days. In how many days, would all of them complete the same work working together?

**Solution:** Here, $X = 10$, $Y = 15$ and $Z = 18$.

Therefore, the work will be completed in

$$= \frac{XYZ}{XY + YZ + ZX} \text{ days}$$

$$= \frac{10 \times 15 \times 18}{10 \times 15 + 15 \times 18 + 18 \times 10} \text{ days}$$

i.e., $\dfrac{2700}{600}$ or, $4\dfrac{1}{2}$ days.

3. Two persons, A and B, working together, can complete a piece of work in $X$ days. If A, working alone, can complete the work in $Y$ days, then B, working alone, will complete the work in $\dfrac{XY}{Y - X}$ days.

**Explanation:**

A and B together can complete the work in $X$ days.

$\therefore$ (A + B)'s 1 day's work $= \dfrac{1}{X}$.

Similarly, A's 1 day's work $= \dfrac{1}{Y}$.

Therefore, B's 1 day's work $= \dfrac{1}{X} - \dfrac{1}{Y} = \dfrac{Y - X}{XY}$.

$\therefore$ B alone can com plete the work in $\left(\dfrac{XY}{Y - X}\right)$ days.

$\therefore$ B alone will complete the work in

$$= \frac{XY}{Y - X} \text{ days} = \frac{15 \times 20}{20 - 15}, \text{ i.e., 60 days.}$$

**Illustration 3:** A and B, working together, take 15 days to complete a piece of work. If A alone can do this work in 20 days, then how long would B take to complete the same work?

**Solution:** Here, $X = 15$ and $Y = 20$.

4. If A and B, working together, can finish a piece of work in $X$ days, B and C in $Y$ days, C and A in $Z$ days, then
   (a) A, B and C working together, will complete the job in $\left(\dfrac{2XYZ}{XY + YZ + ZX}\right)$ days.
   (b) A alone will complete the job in $\left(\dfrac{2XYZ}{XY + YZ - ZX}\right)$ days.
   (c) B alone will complete the job in $\left(\dfrac{2XYZ}{ZX + XY - YZ}\right)$ days.

**Explanation:**

(A + B)'s 1 day's work $= \dfrac{1}{X}$

(B + C)'s 1 day's work $= \dfrac{1}{Y}$

(C + A)'s 1 day's work $= \dfrac{1}{Z}$.

So, [(A + B) + (B + C) + (C + A)]'s 1 day's work $= \dfrac{1}{X} + \dfrac{1}{Y} + \dfrac{1}{Z}$.

or, $2$(A + B + C)'s 1 day's work $= \left(\dfrac{1}{X} + \dfrac{1}{Y} + \dfrac{1}{Z}\right)$

or, (A + B + C)'s 1 day's work $= \dfrac{1}{2}\left(\dfrac{1}{X} + \dfrac{1}{Y} + \dfrac{1}{Z}\right)$

i.e., $\left(\dfrac{XY + YZ + ZX}{2XYZ}\right)$

$\therefore$ A, B and C, working together, will complete the work in $\left(\dfrac{2XYZ}{XY + YZ + ZX}\right)$ days.

Also, A's 1 day's work = (A + B + C)'s 1 day's work −(B + C)'s 1 day's work

$$= \frac{1}{2}\left(\frac{1}{X}+\frac{1}{Y}+\frac{1}{Z}\right)-\frac{1}{Y} = \frac{1}{2}\left(\frac{1}{X}-\frac{1}{Y}+\frac{1}{Z}\right)$$

$$= \frac{XY+YZ-ZX}{2XYZ}.$$

So, A alone can do the work in $\left(\frac{2XYZ}{XY+YZ-ZX}\right)$ days.

Similarly, B alone can do the work in $\left(\frac{2XYZ}{YZ+ZX-XY}\right)$ days

and C alone can do the work in $\left(\frac{2XYZ}{ZX+XY-YZ}\right)$ days.

**Illustration 4:** A and B can do a piece of work in 12 days, B and C in 15 days, C and *A* in 20 days. How long would each of them would take separately to complete the same work?

**Solution:** Here, $X = 12$, $Y = 15$ and $Z = 20$.

∴ A alone can do the work in

$$= \frac{2XYZ}{XY+YZ-ZX}$$

$$= \frac{2\times12\times15\times20}{12\times15+15\times20-20\times12} \text{ days}$$

or, $\frac{7200}{240}$, i.e., 30 days.

B alone can do the work in

$$= \frac{2XYZ}{YZ+ZX-XY} \text{ days}$$

$$= \frac{2\times12\times15\times20}{15\times20+20\times12-12\times15} \text{ days}$$

or, $\frac{7200}{360}$, i.e., 20 days.

C alone can do the work in

$$= \frac{2XYZ}{ZX+XY-YZ} \text{ days}$$

$$= \frac{2\times12\times15\times20}{20\times12+12\times15-15\times20} \text{ days}$$

or, $\frac{7200}{120}$, i.e., 60 days.

5. (a) If A can complete a work in *X* days and B is *k* times efficient than A, then the time taken by both A and B, working together, to complete the work is $\frac{x}{1+k}$.

   (b) If A and B, working together, can complete a work in *X* days and B is *k* times efficient than A, then the time taken by

   (i) A, working alone, to complete the work is $(k + 1) X$.

   (ii) B, working alone, to complete the work is $\left(\frac{k+1}{k}\right)X$.

**Illustration 5:** Harbans Lal can do a piece of work in 24 days. If Bansi Lal works twice as fast as Harbans Lal, then how long would they take to complete the work working together?

**Solution:** Here, $X = 24$ and, $k = 2$.

∴ Time taken by Harbans Lal and Bansi Lal, working together, to complete the work

$$= \left(\frac{X}{1+k}\right) \text{ days.}$$

$$= \left(\frac{24}{1+2}\right) \text{ days, i.e., 8 days.}$$

**Illustration 6:** A and B together can do a piece of work in 3 days. If A does thrice as much work as B in a given time, find, how long A alone would take to do the work?

**Solution:** Here, $X = 3$ and $k = 3$.

∴ Time taken by A, working alone, to complete the work

$$= \left(\frac{k+1}{k}\right)X = \left(\frac{3+1}{3}\right)3 = 4 \text{ days.}$$

6. If A working alone takes *a* days more than A and B working alone takes *b* days more than A and B together, then the number of days taken by A and B, working together, to finish a job is given by $\sqrt{ab}$.

**Illustration 7:** A alone would take 8 hours more to complete the job than if both A and B worked together. If B worked alone, he took $4\frac{1}{2}$ hours more to complete the job than A and B worked together. What time would they take if both A and B worked together?

**Solution:** Here, $a = 8$ and $b = \frac{9}{2}$.

∴ Time taken by A and B, working together, to complete the job

$$= \sqrt{ab} \text{ days}$$

$$= \sqrt{8\times\frac{9}{2}} \quad \text{or,} \quad 6 \text{ days.}$$

7. If A is $k$ times more efficient than B and is, therefore, able to complete a work in $l$ days less than B, then
   (a) A and B, working together, can finish the work in $\frac{kl}{k^2-1}$ days.
   (b) A, working alone, can finish the work in $\frac{l}{k-1}$ days.
   (c) B, working alone, can finish the work in $\frac{kl}{k-1}$ days.

**Illustration 8:** A is thrice as good a workman as B and takes 10 days less to complete a piece of work than B takes. Find out time in which B alone can complete the work.

**Solution:** Here, $k = 3$ and $l = 10$.

$\therefore$ Time taken by B, working alone, to complete the work

$$= \frac{kl}{k-1} \text{ days}$$

$$= \frac{3 \times 10}{3-1} \text{ days, i.e., 15 days.}$$

8. If A can complete $\frac{a}{b}$ part of work in $X$ days, then $\frac{c}{d}$ part of the work will be done in $\frac{b \times c \times X}{a \times d}$ days.

**Illustration 9:** A completes $\frac{3}{4}$ of a work in 12 days. In how many days he would complete $\frac{1}{8}$ of the work?

**Solution:** Here, $a = 3$, $b = 4$, $X = 12$, $c = 1$ and $d = 8$.

Therefore, number of days required to complete $\frac{1}{8}$ of the work

$$= \frac{b \times c \times X}{a \times d} = \frac{4 \times 1 \times 12}{3 \times 8} = 2 \text{ days.}$$

9. (a) There are two groups of people with same level of efficiency. In one group, $M_1$ persons can do $W_1$ works in $D_1$ time and in the other group, $M_2$ persons can do $W_2$ works in $D_2$ time. The relationship between the two groups is given by
   $M_1D_1W_2 = M_2D_2W_1$
   (b) There are two groups of people with same efficiency. In group, $M_1$ persons can do $W_1$ works in $D_1$ time working $t_1$ hours a day and $M_2$ persons can do $W_2$ works in $D_2$ time working $t_2$ hours a day. The relationship between the two groups is given by
   $M_1D_1t_1W_2 = M_2D_2t_2W_1$.

**Illustration 10:** If 10 persons can complete 2/5 of a work in 8 days, then find out the number of persons required to complete the remaining work in 12 days.

**Solution:** We have, $M_1 = 10$, $W_2 = \frac{2}{5}$, $D_1 = 8$

$M_2 = ?$, $W_2 = \frac{3}{5}$, $D_2 = 12$.

$\therefore \quad M_1D_1W_2 = M_2D_2W_1$

$\Rightarrow \quad 10 \times 8 \times \frac{23}{5} = M_2 \times 12 \times \frac{2}{5}$

$\Rightarrow \quad M_2 = 10.$

**Illustration 11:** If 10 persons can cut 20 trees in 3 days by working 12 hours a day. Then, in how many days can 24 persons cut 32 trees by working 4 hours a day?

**Solution:** We have, $M_1 = 10$, $W_1 = 20$, $D_1 = 3$, $t_1 = 12$

$M_2 = 24$, $W_2 = 32$, $D_2 = ?$, $t_2 = 4$

$\therefore \quad M_1D_1t_1W_2 = M_2D_2t_2W_1$

$\Rightarrow \quad 10 \times 3 \times 12 \times 32 = 24 \times D_2 \times 4 \times 20$

$\Rightarrow \quad D_2 = 6$ days.

10. If $a$ men and $b$ women can do a piece of work in $n$ days, then $c$ men and $d$ women can do the work in
$$\left(\frac{nab}{bc+ad}\right) \text{ days.}$$

**Illustration 12:** 12 men or 15 women can do a work in 14 days. In how many days, 7 men and 5 women would complete the work?

**Solution:** Here, $a = 12$, $b = 15$, $n = 14$, $c = 7$ and $d=5$.

Required number of days

$$= \frac{nab}{bc+ad} = \left(\frac{14 \times 12 \times 15}{15 \times 7 + 12 \times 5}\right) \text{days}$$

$$= \frac{168}{11} \text{ days} \quad \text{or,} \quad 15\frac{3}{11} \text{ days.}$$

## EXERCISE 1

**1.** 10 men can complete a piece of work in 15 days and 15 women can complete the same work in 12 days. If all the 10 men and 15 women work together, in how many days will the work will be completed?

(a) $6\frac{2}{3}$ days (b) $8\frac{1}{3}$ days

(c) $7\frac{2}{3}$ days (d) None of these

**2.** A can do a piece of work in 30 days while B can do it in 40 days. A and B working together can do it in:

(a) $15\frac{2}{7}$ days (b) $17\frac{1}{7}$ days

(c) $18\frac{3}{7}$ days (d) None of these

**3.** A can do 1/3 of a work in 5 days and B can do 2/5 of the work in 10 days. In how many days both A and B together can do the work?

(a) $13\frac{2}{3}$ days (b) $9\frac{3}{8}$ days

(c) $18\frac{5}{8}$ days (d) None of these

**4.** A, B and C can complete a piece of work in 6, 12 and 24 days. They altogether will complete the work in:

(a) $5\frac{2}{7}$ days (b) $4\frac{3}{7}$ days

(c) $3\frac{3}{7}$ days (d) None of these

**5.** A works thrice as good as B and is, therefore, able to finish a piece of work in 60 days less than B. Find the time in which they can complete it, working together.

(a) $22\frac{3}{4}$ days (b) $22\frac{1}{2}$ days

(c) 24 days (d) None of these

**6.** Ramesh takes twice as much time as Mahesh and thrice as much time as Suresh to complete a job. If working together, they can complete the job in 4 days, then the time taken by each of them separately to complete the work is:

(a) 36, 24 and 16 days (b) 20, 16 and 12 days
(c) 24, 42 and 18 days (d) None of these

**7.** Sita takes twice as much time as Gita to complete a work and Rita does it in the same time as Sita and Gita together. If all three working together can finish the work in 6 days, then the time taken by each of them to finish the work is:

(a) 18, 36, and 12 days
(b) 20, 38 and 14 days
(c) 24, 42 and 18 days
(d) None of these

**8.** 5 men can complete a work in 2 days, 4 women can complete the same work in 3 days and 5 children can do it in 3 days. 1 man, 1 woman and 1 child, working together, can complete the work in:

(a) 6 days (b) 4 days
(c) 8 days (d) None of these

**9.** A and B can complete piece of work in 6 days and A alone can complete it in 9 days. The time taken by B alone to complete the work is:

(a) 20 days (b) 18 days
(c) 24 days (d) None of these

**10.** A and B can complete a piece of work in 30 days, B and C in 40 days while C and A in 60 days. A, B, C together can complete the work in:

(a) $24\frac{3}{4}$ days (b) $28\frac{2}{3}$ days

(c) $26\frac{2}{3}$ days (d) None of these

**11.** A and B can complete a piece of work in 18 days; B and C in 24 days; C and A in 36 days. A alone can complete the work in:

(a) 48 days (b) 56 days
(c) 40 days (d) None of these

**12.** Ajay and Sunil together can complete a piece of work in 10 days, Sunil and Sanjay in 15 days and Sanjay and Ajay in 20 days. They worked together for 6 days, and then Ajay leaves. Sunil and Sanjay worked together for 4 more days, and Sunil leaves. How long will Sanjay take to complete the work?

(a) 12 days (b) 10 days
(c) 16 days (d) None of these

**13.** Anu can complete a work in 10 days. Manu is 25% more efficient than Anu, and Sonu is 60% more efficient than Manu. Working together, how long would they take to finish the job?

(a) $3\frac{5}{8}$ days (b) $5\frac{6}{7}$ days

(c) $2\frac{6}{17}$ days (d) None of these

**14.** A and B completes job in 12 days while A, B and C can complete it in 8 days. C alone will finish the job in:

(a) 24 days (b) 36 days
(c) 28 days (d) None of these

**15.** Bansal, Gupta and Singhal together can complete a work in 4 days. If Bansal and Gupta together can complete the work in $4\frac{4}{5}$ days, Gupta and Singhal togehter can do it in 8 days, then Gupta alone can complete the work in:

(a) 16 days (b) 12 days
(c) 20 days (d) None of these

**16.** Nikita, Nishita and Kavita can complete a work in $2\frac{2}{3}$ days. If Nishita and Kavita can complete it in 4 days, and Nishita alone can do it in 6 days, then Nikita and Nishita can complete the work in:

(a) $5\frac{4}{7}$ days (b) $4\frac{2}{7}$ days

(c) $3\frac{3}{7}$ days (d) None of these

**17.** A is twice as good a workman as B. Working together they finish a piece of work in 1 day. A alone can finish the work in:

(a) 28 days (b) 21 days
(c) 24 days (d) None of these

**18.** Bindal can finish a work in 10 days. Jindal is twice as efficient as Bindal. If they work together, in how many days, the work will be completed?

(a) $3\frac{1}{3}$ days (b) $5\frac{2}{3}$ days

(c) $4\frac{1}{3}$ days (d) None of these

**19.** A alone would take 27 days more to complete the job than if both A and B would together. If B worked alone, he took 3 days more to complete the job than A and B worked together. What time would they take if both A and B worked together?

(a) 7 days (b) 9 days
(c) 11 days (d) None of these

**20.** A is 4 times as fast as B and is, therefore, able to complete a work in 45 days less than B. A and B, working together, can complete the work in:

(a) 12 days (b) 16 days
(c) 8 days (d) None of these

**21.** If A can complete a work in 16 days, then in how many days can he complete $\frac{3}{4}$ of the work?

(a) 16 days (b) 20 days
(c) 12 days (d) None of these

**22.** Working 7 hours daily 24 men can complete a piece of work in 27 days. In how many days would 14 men complete the same piece of work working 9 hours daily?

(a) 36 days (b) 30 days
(c) 32 days (d) None of these

**23.** 10 men can cut 15 trees in 2 hours. If 2 men leave the job, then many trees will be cut in 3 hours?

(a) 20 trees (b) 18 trees
(c) 24 trees (d) None of these

**24.** 45 men completes a piece of work in 30 days working 12 hours a day. In how many days will 60 men complete the work working 10 hours a day?

(a) 27 days (b) 30 days
(c) 24 days (d) None of these

**25.** The work done by a woman in 8 hours is equal to the work done by a man in 6 hours and by a boy in 12 hours. If working 6 hours per day 9 men can complete a work in 6 days, then in how many days can 12 men, 12 women and 12 boys together finish the same work working 8 hours per day?

(a) $2\frac{1}{2}$ days (b) $1\frac{1}{2}$ days

(c) $3\frac{1}{2}$ days (d) None of these

**26.** 4 men or 6 women can finish a piece of work in 20 days. In how many days can 6 men and 11 women finish the same work?

(a) 9 days (b) 6 days
(c) 7 days (d) None of these

**27.** 10 men can finish a piece of work in 10 days, whereas it takes 12 women to finish it in 10 days. If 15 men and 6 women undertake to complete the work, how many days will they take to complete it?

(a) 7 days (b) 5 days
(c) 9 days (d) None of these

**28.** A can complete a piece of work in 10 days, while B alone can complete it in 15 days. They work together for 5 days and rest of the work is done by C in 2 days. If they receive ₹450 for the whole work, how should they divide the money?

(a) ₹250, ₹100, ₹100 (b) ₹225, ₹150, ₹75
(c) ₹200, ₹150, ₹100 (d) ₹175, ₹175, ₹100

**29.** The first man alone can complete this work in 7 days. The second man alone can do this work in 8 days. If they are working together to complete this work in 3 days and also taking help of a boy, then how should the money be divided?

(a) ₹600, ₹500, ₹300 (b) ₹600, ₹525, ₹275
(c) ₹600, ₹550, ₹250 (d) ₹500, ₹525, ₹375

**30.** A does half as much work as B in 3/4 of the time. If together they take 18 days to complete a work, then how much time shall B take to complete it?

(a) 30 days (b) 35 days
(c) 40 days (d) None of these

**31.** Two men, A and B, working together, completed a piece of work. If worked individually, it would have taken them 30 and 40 days to complete the work. If they have received a payment of ₹2100, then B's share is:

(a) ₹900 (b) ₹1200
(c) ₹800 (d) ₹1300

**32.** Two men undertake a piece of work for ₹600. Individually, they can complete the work in 6 days and 8 days, respectively. With the assistance of a boy they completed the work in 3 days. The boy's share should be:

(a) ₹300 (b) ₹225
(c) ₹75 (d) ₹100

**33.** A can do a piece of work in 8 days. A undertook to it for ₹320. With the help of B, he finishes the work in 6 days. B's share is:

(a) ₹80 (b) ₹240
(c) ₹100 (d) ₹120

**34.** Five men and 2 boys, working together, can complete four times as much work per hour as a man and a boy completes working together. The work completed by a man and a boy should be in the ratio:

(a) 1:2 (b) 2:1
(c) 1:3 (d) 4:1

**35.** A, B and C can do a piece of work in 16, 32 and 48 days, respectively. They started working together, but C left after working 4 days and B left 2 days before the completion of work. Total number of days taken for completion of work was:

(a) 8 days (b) $9\frac{1}{9}$ days

(c) 11 days (d) $10\frac{4}{9}$ days

**36.** A and B, working separately, can complete a piece of work in 9 and 12 days, respectively. If they work for a day alternately, A beginning, in how many days the work will be completed?

(a) $10\frac{1}{2}$ days (b) $10\frac{1}{4}$ days

(c) $10\frac{2}{3}$ days (d) $10\frac{1}{2}$ days

**37.** A and B can complete a piece of work in 45 and 40 days, respectively. They began the work together, but A leaves after some days and B completed the remaining work in 23 days. After how many days did A leave?

(a) 6 days (b) 8 days
(c) 9 days (d) 12 days

**38.** A and B, working together, can complete a piece of work in 12 days B and C working together can complete the same piece of work in 16 days. A worked at it for 5 days and B worked at it for 7 days. C finished the remaining work in 13 days. How many days would C alone take to complete it?

(a) 10 days (b) 24 days
(c) 32 days (d) 40 days

**39.** A can complete a piece of work in 90 days. He starts working, but having some other engagements leaves after 5 days. Thereafter, B completes this work in 21 days. How many days would A and B take to complete this work working together?

(a) 15 days (b) 16 days
(c) 17 days (d) 11 days

**40.** A can do a piece of work in 30 days, B in 50 days and C in 40 days. If A is assisted by B on one day and by C on the next day alternately, the work will be completed in:

(a) $17\frac{32}{35}$ days (b) $19\frac{2}{3}$ days

(c) $16\frac{31}{37}$ days (d) $18\frac{1}{3}$ days

## EXERCISE–2
## (BASED ON MEMORY)

**1.** 56 men can complete a piece of work in 24 days. In how many days can 42 men complete the same piece of work?

(a) 18 (b) 32
(c) 98 (d) 48
(e) None of these

**[Bank of Maharashtra PO, 2008]**

**2.** Four examiners can examine a certain number of answer papers in 10 days by working 5 hours a day. For how many hours a day would 2 examiners have to work in order to examine twice the number of answer papers in 20 days?

(a) 8 hours (b) $7\frac{1}{2}$ hours
(c) 10 hours (d) $8\frac{1}{2}$ hours
(e) None of these

**[Bank of Maharashtra PO, 2008]**

**3.** 'A' can complete a piece of work in 12 days. 'A' and 'B' together can complete the same piece of work in 8 days. In how many days can 'B' alone complete the same piece of work?

(a) 15 days (b) 18 days
(c) 24 days (d) 28 days
(e) None of these

**[SBI PO, 2008]**

**4.** 4 men, 5 women and 3 children together can complete a piece of work in 16 days. In how many days can 10 women alone complete the piece of work if 10 men alone can complete it in 24 days?

(a) 18 (b) 15
(c) 12 (d) Cannot be determined
(e) None of these

**[Bank of Maharashtra PO, 2007]**

**5.** 15 men can do a piece of work in 6 days. How many men would be required to do the same work in 7.5 days?

(a) 10 (b) 16
(c) 12 (d) 20
(e) None of these

**[Corporation Bank PO, 2007]**

**6.** 'A' alone can complete a piece of work in 8 days. Work done by 'B' alone in one day is half of the work done by 'A' alone in one day. In how many days can the work be completed if 'A' and 'B' work together?

(a) $6\frac{1}{2}$ (b) $5\frac{1}{2}$
(c) $5\frac{1}{3}$ (d) $6\frac{1}{2}$
(e) None of these

**[PNB Management Trainee, 2007]**

**7.** 24 men can complete a piece of work in 16 days. The same work can be completed by 8 women in 72 days, whereas 24 children take 32 days to complete it. If 10 men, 15 women and 24 children work together, in how many days can the work be completed?

(a) 18 (b) 8
(c) 22 (d) 12
(e) None of these

**[Allahabad Bank PO, 2007]**

**8.** 8 men alone can complete a piece of work in 12 days, 4 women alone can complete the same piece of work in 48 days and 10 children alone can complete the piece of work in 24 days. In how many days can 10 men, 4 women and 10 children together complete the piece of work?

(a) 5 (b) 15
(c) 28 (d) 6
(e) None of these

**[CBI PO, 2006]**

**9.** 'A' can complete a piece of work in 12 days. 'A' and 'B' together can complete the same piece of work in 4 days. In how many days can 'B' alone complete the same piece of work?

(a) 6 days (b) 8 days
(c) 15 days (d) 18 days
(e) None of these

**[Bank of Maharashtra PO, 2006]**

**10.** 9 children can complete a piece of work in 360 days. 18 men can complete the same piece of work in 72 days and 12 women can complete the piece of work in 162 days. In how many days can 4 men, 12 women and 10 children together complete the piece of work?

(a) 124 (b) 81
(c) 68 (d) 96
(e) None of these

**[Corporation Bank PO, 2006]**

**11.** A and B together can do a work in 8 days, B and C together in 6 days, while C and A together in 10 days. If they all work together, then the work will be completed in:

(a) $3\frac{3}{4}$ days (b) $3\frac{3}{7}$ days

(c) $5\frac{5}{47}$ days (d) $4\frac{4}{9}$ days

**[SSC (GL) Prel. Examination, 2005]**

**12.** A work could be completed in 100 days by some workers. However, due to the absence of 10 workers, it was completed in 110 days. The original number of workers was:

(a) 100 (b) 110

(c) 55 (d) 50

**[SSC (GL) Prel. Examination, 2005]**

**13.** A and B can do a piece of work in 12 days, B and C in 8 days and C and A in 6 days. How long would B take to do the same work alone?

(a) 24 days (b) 32 days

(c) 40 days (d) 48 days

**[SSC (GL) Prel. Examination, 2005]**

**14.** A man and a boy received ₹800 as wages for 5 days for the work they did together. The man's efficiency in the work was three times that of the boy. What are the daily wages of the boy?

(a) ₹76 (b) ₹56

(c) ₹44 (d) ₹40

**[SSC (GL) Prel. Examination, 2005]**

**15.** A completes $\frac{7}{10}$ of a work in 15 days. He completes the remaining work with the help of B in 4 days. The time required for A and B together to complete the entire work is:

(a) $10\frac{1}{3}$ days (b) $12\frac{2}{3}$ days

(c) $13\frac{1}{3}$ days (d) $8\frac{1}{4}$ days

**[SSC (GL) Prel. Examination, 2005]**

**16.** A man, a woman and a boy can together complete a piece of work in 3 days. If a man alone can do it in 6 days and a boy alone can do it in 18 days, how long will a woman alone take to complete the work?

(a) 9 days (b) 21 days

(c) 24 days (d) 27 days

**[SSC (GL) Prel. Examination, 2000]**

**17.** A and B can do a piece of work in 10 days, B and C in 15 days and A and C in 20 days. C alone can do the work in:

(a) 60 days (b) 120 days

(c) 80 days (d) 30 days

**[SSC (GL) Prel. Examination, 2002]**

**18.** A can cultivate $\frac{2}{5}$ of a land in 6 days and B can cultivate $\frac{1}{3}$ of the same land in 10 days. Working together, A and B can cultivate $\frac{4}{5}$ of the land in:

(a) 4 days (b) 5 days

(c) 8 days (d) 10 days

**[SSC (GL) Prel. Examination, 2002]**

**19.** A does half as much work as B in $\frac{1}{6}$ of the time. If together they take 10 days to complete a work, how many days shall B take to do it alone?

(a) 70 days (b) 30 days

(c) 40 days (d) 50 days

**[SSC (GL) Prel. Examination, 2002]**

**20.** A can do a piece of work in 4 hours, B and C can do it in 3 hours; A and C can do it in 2 hours. How long will B alone take to do it?

(a) 10 hours (b) 12 hours

(c) 8 hours (d) 24 hours

**[SSC (GL) Prel. Examination, 2002]**

**21.** A does $\frac{4}{5}$ of a piece of work in 20 days; he then calls in B and they finish the remaining work in 3 days. How long will B alone take to do the whole work?

(a) $37\frac{1}{2}$ days (b) 37 days

(c) 40 days (d) 23 days

**[SSC (GL) Prel. Examination, 2002]**

**22.** A can finish a work in 18 days and B can do the same work in half the time taken by A. Then, working together what part of the same work can they finish in a day?

(a) $\frac{1}{6}$ (*b*) $\frac{2}{5}$

(c) $\frac{1}{9}$ (d) $\frac{2}{7}$

**[SSC (GL) Prel. Examination, 2002]**

**23.** A and B can finish a piece of work in 30 days, B and C can finish it in 15 days while C and A can

finish it in 10 days. Time taken by them together to do this work is:

(a) 5 days (b) $2\frac{1}{2}$ days

(c) $7\frac{1}{2}$ days (d) 10 days

**[SSC (GL) Prel. Examination, 2002]**

**24.** A can do $\frac{1}{4}$ part of a work in 10 days, B can do 40% of the work in 40 days and C can do $\frac{1}{3}$ of the work in 13 days. Who will complete the work first?

(a) A (b) B
(c) C (d) A and C both

**[SSC (GL) Prel. Examination, 2002]**

**25.** A takes twice as much time as B or thrice as much time as C to finish a piece of work. Working together, they can finish the work in 2 days. B can do the work alone in:

(a) 12 days (b) 4 days
(c) 8 days (d) 6 days

**[SSC (GL) Prel. Examination, 2002]**

**26.** A and B can together finish a work in 30 days. They worked together for 20 days and then B left. After another 20 days A finished the remaining work. In how many days can A alone finish the job?

(a) 50 days (b) 60 days
(c) 40 days (d) 65 days

**[SSC (GL) Prel. Examination, 2003]**

**27.** If 72 men can build a wall 280 m long in 21 days, how many men will take 18 days to build a similar type of wall of length 100 m?

(a) 30 (b) 10
(c) 18 (d) 28

**[SSC (GL) Prel. Examination, 2003]**

**28.** Babu and Asha can do a job together in 7 days. Asha is $1\frac{3}{4}$ times as efficient as Babu. The same job can be done by Asha alone in:

(a) $\frac{49}{4}$ days (b) $\frac{49}{3}$ days

(c) 11 days (d) $\frac{28}{3}$ days

**[SSC (GL) Prel. Examination, 2003]**

**29.** If 3 men or 4 women can plough a field in 43 days, how long will 7 men and 5 women take to plough it?

(a) 10 days (b) 11 days
(c) 9 days (d) 12 days

**[SSC (GL) Prel. Examination, 2003]**

**30.** 8 men can do a work in 12 days. After 6 days of work, 4 more men were engaged to finish the work. In how many days would the remaining work be completed?

(a) 2 (b) 3
(c) 4 (d) 5

**[SSC (GL) Prel. Examination, 2003]**

**31.** A can finish a work in 24 days, B in 9 days and C in 12 days. B and C start the work but are forced to leave after 3 days. The remaining work is done by A in:

(a) 5 days (b) 6 days

(c) 10 days (d) $10\frac{1}{2}$ days

**[SSC (GL) Prel. Examination, 2003]**

**32.** A and B undertook to do a piece of work for ₹4500. A alone could do it in 8 days and B alone in 12 days. With the assistance of C they finished the work in 4 days. Then C's share of the money is:

(a) ₹2250 (b) ₹1500
(c) ₹750 (d) ₹375

**[SSC (GL) Prel. Examination, 2003]**

**33.** If 6 persons working 8 hours a day earn ₹8400 per week, then 9 persons working 6 hours a day will earn per week:

(a) ₹8400 (b) ₹16800
(c) ₹9450 (d) ₹16200

**[SSC (GL) Prel. Examination, 2003]**

**34.** A can do a certain work in the same time in which B and C together can do it. If A and B together could do it in 10 days and C alone in 50 days, then B alone could do the work in:

(a) 15 days (b) 20 days
(c) 25 days (d) 30 days

**[SSC (GL) Prel. Examination, 2003]**

**35.** 24 men can complete a work in 16 days. 32 women can complete the same work in 24 days. 16 men and 16 women started working and worked for 12 days. How many more men are to be added to complete the remaining work in 2 days?

(a) 48 (b) 24
(c) 36 (d) 16

**[Bank of Baroda PO, 1999]**

**36.** 10 men can complete a piece of work in 15 days and 15 women can complete the same work in 12 days. If all the 10 men and 15 women work together, in how many days will the work get completed?

(a) 6 (b) $7\frac{2}{3}$
(c) $6\frac{2}{3}$ (d) None of these

**[SBI Associates PO, 1999]**

**37.** 25 men and 15 women can complete a piece of work in 12 days. All of them start working together and after working for 8 days the women stopped working. 25 men completed the remaining work in 6 days. How many days will it take for completing the entire job if only 15 women are put on the job?

(a) 60 days (b) 88 days
(c) 94 days (d) 50 days
(e) None of these

**[Guwahati PO, 1999]**

**38.** 'A' completes a work in 12 days. 'B' completes the same work in 15 days. 'A' started working alone and after 3 days B joined him. How many days will they now take together to complete the remaining work?

(a) 5 (b) 8
(c) 6 (d) 4
(e) None of these

**[BSRB Calcutta PO, 1999]**

**39.** 10 men and 15 women finish a work in 6 days. One man alone finishes that work in 100 days. In how many days will a woman finish the work?

(a) 125 days (b) 150 days
(c) 90 days (d) 225 days
(e) None of these

**[BSRB Hyderabad PO, 1999]**

**40.** The work done by a woman in 8 hours is equal to the work done by a man in 6 hours and by a boy in 21 hours. If working 6 hours per day 9 men can complete a work in 6 days then in how many days can 12 men, 12 women and 12 boys together finish the same work working 8 hours per day?

(a) $1\frac{1}{3}$ days (b) $3\frac{2}{3}$ days
(c) 3 days (d) $1\frac{1}{2}$ days
(e) None of these

**[BSRB Patna PO, 2001]**

**41.** 7 men and four boys can complete a work in 6 days. A man completes double the work than a boy. In how many days will 5 men and 4 boys complete the work?

(a) 5 (b) 4
(c) 6 (d) Cannot be determined
(e) None of these

**[IBPS Bank PO, 2002]**

**42.** Vinod can complete a job in 15 hours. Vinay alone can complete the same job in 10 hours. Vinod works for 9 hours and then the remaining job is completed by Vinay. How many hours will it take Vinay to complete the remaining job alone?

(a) 4 (b) 5
(c) 6 (d) 2

**[IBPS Jr Executive, 2002]**

**43.** 7 men can complete a piece of work in 12 days. How many additional men will be required to complete double the work in 8 days?

(a) 28 (b) 21
(c) 14 (d) 7

**[SSC (GL) Examination, 2010]**

**44.** X is three times as fast as Y and is able to complete the work in 40 days less than Y. Then the time in which they can complete the work together is:

(a) 15 days (b) 10 days
(c) $7\frac{1}{2}$ days (d) 5 days

**[SSC (GL) Examination, 2011]**

**45.** A can do a work in 12 days. When he had worked for 3 days, B joined him. If they complete the work in 3 more days, in how many days can B alone finish the work?

(a) 6 days (b) 12 days
(c) 4 days (d) 8 days

**[SSC (GL) Examination, 2011]**

**46.** A is thrice as good a workman as B, therefore, A is able to finish a piece of work in 60 days less that B. The time (in days) in which they can do it working together is:

(a) 22 (b) $22\frac{1}{2}$
(c) 23 (d) $23\frac{1}{4}$

**[SSC (GL) Examination, 2011]**

**47.** A work can be completed by P and Q in 12 days, Q and R in 15 days, R and P in 20 days. In how many days P alone can finish the work?

(a) 10 (b) 20
(c) 30 (d) 60

**[SSC (GL) Examination, 2011]**

**48.** '$x$' number of men can finish a piece of work in 30 days. If there were 6 men more, the work could be finished in 10 days less. The actual number of men is:

(a) 6 (b) 10
(c) 12 (d) 15

**[SSC (GL) Examination, 2011]**

**49.** A does half as much work as B in $\frac{3}{4}$ of the time. If together they take 18 days to complete a work. How much time shall B take to do it alone?

(a) 30 days (b) 35 days
(c) 40 days (d) 45 days

**[SSC (GL) Examination, 2011]**

**50.** A and B working separately can do a piece of work in 9 and 12 days, respectively. If they work for a day alternately with A beginning, the work would be completed in:

(a) $10\frac{2}{3}$ days (b) $10\frac{1}{2}$ days
(c) $10\frac{1}{4}$ days (d) $10\frac{1}{3}$ days

**[SSC (GL) Examination, 2011]**

**51.** A daily wage earner gets a daily wage at the rate of ₹150 per day subject to the condition that he will have to pay a penalty at the rate of ₹25 per day for the days he is absent. At the end of 60 days, he receives an amount of ₹7,600. The number of days A worked is:

(a) 54 days (b) 52 days
(c) 51 days (d) 48 days

**[UPPCS Examination, 2012]**

**52.** 6 men can complete a piece of work in 12 days. 8 women can complete the same piece of work in 18 days, whereas 15 children can complete the piece of work in 10 days. 4 men, 12 women and 20 children work together for 2 days. If only men were to complete the remaining work in 1 day how many men would be required?

(a) 36 (b) 24
(c) 18 (d) Cannot be determined

**[Bank of India PO Examination, 2010]**

**53.** 2 men alone or three women alone can complete a piece of work in 4 days. In how many days can 1 woman and 1 man together complete the same piece of work?

(a) 6 days (b) $\frac{24}{5}$ days
(c) $\frac{12}{1.75}$ days (d) Cannot be determined

**[Corporation Bank PO Examination, 2011]**

**54.** 4 girls can complete a piece of work in 8 days, the same work 3 boys can complete in 9 days, 7 men in 2 days and 5 women in 4 days. Who among them have the minimum capacity of work?

(a) Boy (b) Girl
(c) Man (d) Woman

**[Union Bank of India PO Examination, 2011]**

**55.** Work done by A in one day is half of the work done by B in one day. Work done by B is half of the work done by C in one day. If C alone can complete the work in 7 days, in how many days can A, B and C together complete the work?

(a) 28 (b) 14
(c) 4 (d) 21

**[SBI PO Examination, 2008]**

**56.** 8 men and 4 women together can complete a piece of work in 6 days. Work done by a man in one day is double the work done by a woman is one day. If 8 men and 4 women started working and after 2 days, 4 men left and 4 new women joined. In how many more days will the work be completed?

(a) 5 days (b) 8 days
(c) 6 days (d) 4 days

**[United Bank of India PO Examination, 2009]**

**57.** B and C together can complete a work in 8 days, A and B together can complete the same work in 12 days, and A and C together can complete the same work in 16 days. In, how many days can A, B and C together complete the same work?

(a) $3\frac{9}{13}$ (b) $7\frac{5}{13}$
(c) $7\frac{5}{12}$ (d) $3\frac{5}{12}$

**[Andhra Bank PO Examination, 2009]**

**58.** 8 men can complete a piece of work in 20 days. 8 women can complete the same work in 32 days. In how many days will 5 men and 8 women together complete the same work?

(a) 16 days (b) 12 days
(c) 14 days (d) 10 days

**[CBI (PO) Examination, 2010]**

**59.** A, B and C are employed to do a piece of work for ₹575. A and C are supposed to finish $\frac{19}{23}$ of the work together. Amount shall be paid to B is:

(a) ₹210 (b) ₹100
(c) ₹200 (d) ₹475

**[SSC, 2014]**

**60.** A man is twice as fast as a woman and a woman is twice as fast as a boy in doing a work. If all of them, a man, a woman and a boy, can finish the work in 7 days, in how many days a boy will do it alone?

(a) 49 (b) 7
(c) 6 (d) 42

**[SSC, 2014]**

**61.** A, B and C can do a job in 6 days, 12 days and 15 days, respectively. After $\frac{1}{8}$ of the work is completed, C leaves the job. Rest of the work is done by A and B together. Time taken to finish the work is:

(a) $5\frac{5}{6}$ days (b) $5\frac{1}{4}$ days
(c) $3\frac{1}{2}$ days (d) $3\frac{3}{4}$ days

**[SSC, 2014]**

**62.** 15 men take 20 days to complete a job working 8 hours a day. The number of hours a day should 20 men take to complete the job in 12 days is:

(a) 5 hours (b) 10 hours
(c) 15 hours (d) 18 hours

**[SSC, 2014]**

**63.** Raj and Ram working together to do a piece of work in 10 days. Raj alone can do it in 12 days. Ram alone will do the work in:

(a) 20 days (b) 40 days
(c) 50 days (d) 60 days

**[SSC, 2014]**

**64.** If $x$ men can do a piece of work in $x$ days, then the number of days in which $y$ men can do the same work is:

(a) $xy$ days (b) $\frac{y^2}{x}$ days
(c) $\frac{x^2}{y}$ days (d) $x_2y$ days

**[SSC, 2013]**

**65.** 3 persons undertake to complete a piece of work for ₹1,200. The first person can complete the work in 8 days, second person in 12 days and third person in 16 days. They complete the work with the help of a fourth person in 3 days. What does the fourth person get?

(a) ₹180 (b) ₹200
(c) ₹225 (d) ₹250

**[SSC, 2013]**

**66.** Two workers A and B working together completed a job in 5 days. If A worked twice as efficiently as he actually did and B worked $\frac{1}{3}$ as efficiently as he actually did, the work would have been completed in 3 days. To complete the job alone, A would require:

(a) $5\frac{1}{5}$ days (b) $6\frac{1}{4}$ days
(c) $7\frac{1}{2}$ days (d) $8\frac{3}{4}$ days

**[SSC, 2013]**

**67.** A can do a piece of work in 20 days and B in 30 days. They work together for 7 days and then both leave the work. Then C alone finishes the remaining work in 10 days. In how many days will C finish the full work?

(a) 25 days (b) 30 days
(c) 24 days (d) 20 days

**[SSC, 2013]**

**68.** Sunil completes a work in 4 days, whereas Dinesh completes the work in 6 days. Ramesh works $1\frac{1}{2}$ times as fast as Sunil. The three together can complete the work in:

(a) $1\frac{5}{12}$ days (b) $1\frac{5}{7}$ days
(c) $1\frac{3}{8}$ days (d) $1\frac{5}{19}$ days

**[SSC, 2013]**

**69.** A farmer can plough a field working 6 hours per day in 18 days. The worker has to work how many hours per day to finish the same work in 12 days?

(a) 7 (b) 9
(c) 11 (d) 13

**[SSC, 2013]**

**70.** Two men can do a piece of work in $x$ days. But $y$ women can do it in 3 days. Then the ratio of the work done by 1 man and 1 woman is:

(a) $3y:2x$ (b) $2x:3y$
(c) $x:y$ (d) $2y:3x$

**[SSC Assistant Grade III, 2013]**

**71.** A and B can do a job alone in 12 days and 15 days respectively. A starts the work and after 6 days B also joins to finish the work together. For how many days B actually worked on the job?

(a) $3\frac{1}{3}$ (b) $9\frac{1}{3}$

(c) $5\frac{2}{3}$ (d) $6\frac{3}{8}$

**[SSC Assistant Grade III, 2012]**

**72.** A does $\frac{1}{5}$ of a work in a week. B finishes the same in a fortnight. B starts the work and works only for 3 days. Thereafter A completes the job. He will finish it in:

(a) 10 days (b) 7 days
(c) 12 days (d) 28 days

**[SSC, 2012]**

**73.** A can do a certain work in 12 days. B is 60% more efficient than A. How many days will B and A together take to do the same job?

(a) $\frac{80}{13}$ (b) $\frac{70}{13}$

(c) $\frac{75}{13}$ (d) $\frac{60}{13}$

**[SSC, 2012]**

**74.** 2 men and 4 boys can do a piece of work in 10 days, while 4 men and 5 boys can do it in 6 days. Men and boys are paid wages according to their output. If the daily wage of a man is ₹40, then the ratio of daily wages of a man and a boy will be:

(a) 5:3 (b) 5:2
(c) 7:4 (d) 7:3

**[SSC, 2012]**

**75.** A, B and C can do a piece of work in 30, 20 and 10 days respectively. A is assisted by B on one day and by C on the next day, alternately. How long would the work take to finish?

(a) $9\frac{3}{8}$ days (b) $4\frac{4}{8}$ days

(c) $8\frac{4}{13}$ days (d) $3\frac{9}{13}$ days

**[SSC, 2012]**

**76.** A can do a piece of work in 24 days, B in 32 days and C in 64 days. All begin to do it together, but A leaves after 6 days before the completion of the work. How many days did the work last?

(a) 15 (b) 20
(c) 18 (d) 30

**[SSC, 2011]**

**77.** P, Q, R are employed to do a work for ₹5750. P and Q together finished $\frac{19}{23}$ of work and Q and R together finished $\frac{8}{23}$ of work. Wage of Q in rupees, is:

(a) 2850 (b) 3750
(c) 2750 (d) 1000

**[SSC, 2011]**

**78.** A can complete a piece of work in 12 days. B is 60% more efficient than A. The number of days, that B will take to complete the same work, is:

(a) 6 (b) $7\frac{1}{2}$

(b) 8 (d) $8\frac{1}{2}$

**[SSC, 2010]**

**79.** A and B together can complete a piece of work in 12 days and B and C together in 15 days. If A is twice as good a workman as C, then in how many days will B alone complete the same work?

(a) 30 (b) 25
(c) 24 (d) 20

**[SSC, 2010]**

**80.** 4 men and 6 women together can complete a work in 8 days while 3 men and 7 women together can complete it in 10 days. 20 women working together will complete it in:

(a) 36 days (b) 32 days
(c) 24 days (d) 20 days

**[SSC, 2010]**

**81.** A, B and C have to type 506 pages to finish an assignment.A can type a page in 12 minutes, B in 15 minutes and C in24 minutes. If they divide the task into three parts so thatall three of them spend equal amount of time in typing,what is the number of pages that B should type?

(a) 172 (b) 176
(c) 154 (d) 168
(e) 164

**[IBPS PO/MT, 2014]**

**82.** A and B together can complete a task in 20 days. B and C together can complete the same task in 30

days. A and C together can complete the same task in 40 days. What is the ratio of the number of days taken by A when completing the same task alone to the number of days taken by C when completing the same task alone?

(a) 2:5 (b) 2:7
(c) 3:7 (d) 1:5
(e) 3:5

**[IBPS PO/MT, 2012]**

**83.** Amit and Sujit together can complete an assignment of data entry in five days. Sujit's speed is 80% of Amit's speed and the total key depressions in the assignment are 5,76,000. What is Amit's speed in key depressions per hour if they work for 8 hours a day?

(a) 4800 (b) 6400
(c) 8000 (d) 7200
(e) None of these

**[SBI Associates Banks PO, 2011]**

**84.** Four examiners can examine a certain number of answer papers in 10 days by working for five hours a day. For how many hours in a day would two examiners have to work in order to examine twice the number of answer papers in 20 days?

(a) 8 hours (b) $7\frac{1}{2}$ hours

(c) 10 hours (d) $8\frac{1}{2}$ hours

(e) None of these

**[Andhra Bank PO, 2011]**

**85.** 2 men alone or three women alone can complete a piece of work in 4 days. In how many days can 1 woman and one man together complete the same piece of work?

(a) 6 days (b) $\frac{24}{5}$ days

(c) $\frac{12}{1.75}$ days (d) Cannot be determined

(e) None of these

**[Corporation Bank PO, 2011]**

**86.** Four examiners can examine a certain number of answer papers in 10 days by working for 5 hours a day. For how many hours in a day would 2 examiners have to work in order to examine twice the number of answer papers in 20 days?

(a) 8 hours (b) $7\frac{1}{2}$ hours

(c) 10 hours (d) $8\frac{1}{2}$ hours

(e) None of these

**[Punjab and Sind Bank PO, 2011]**

**87.** 12 men complete a piece of work in 24 days. In how many days can 8 men complete the same piece of work?

(a) 28 (b) 36
(c) 48 (d) 52
(e) None of these

**[IDBI Bank PO, 2009]**

**88.** If A works alone, he would take 4 days more to complete the job than if both A and B worked together. If B worked alone, he would take 16 days more to complete the job than if A and B work together. How many days would they take to complete the work if both of them worked together?

(a) 10 days (b) 12 days
(c) 6 days (d) 8 days

**[SSC, 2011]**

**89.** 250 men can finish a work in 20 days working 5 hours a day. To finish the work within 10 days working 8 hours a day, the minimum number of men required is:

(a) 310 (b) 300
(c) 313 (d) 312

**[SSC, 2011]**

**90.** 2 men and 5 women can do a work in 12 days. 5 men and 2 women can do that work in 9 days. Only 3 women can finish the same work in:

(a) 36 days (b) 21 days
(c) 30 days (d) 42 days

**[SSC, 2011]**

## ANSWER KEYS

### Exercise–1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (b) | **3.** (b) | **4.** (c) | **5.** (b) | **6.** (c) | **7.** (a) | **8.** (b) | **9.** (b) | **10.** (c) | **11.** (a) | **12.** (b) | **13.** (c) |
| **14.** (a) | **15.** (b) | **16.** (c) | **17.** (b) | **18.** (a) | **19.** (b) | **20.** (a) | **21.** (c) | **22.** (a) | **23.** (b) | **24.** (a) | **25.** (b) | **26.** (b) |
| **27.** (b) | **28.** (b) | **29.** (b) | **30.** (a) | **31.** (a) | **32.** (c) | **33.** (a) | **34.** (b) | **35.** (d) | **36.** (b) | **37.** (c) | **38.** (b) | **39.** (a) |
| **40.** (a) | | | | | | | | | | | | |

### Exercise–2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (c) | **3.** (c) | **4.** (d) | **5.** (c) | **6.** (c) | **7.** (d) | **8.** (d) | **9.** (a) | **10.** (b) | **11.** (c) | **12.** (b) | **13.** (d) |
| **14.** (d) | **15.** (c) | **16.** (a) | **17.** (b) | **18.** (c) | **19.** (c) | **20.** (b) | **21.** (a) | **22.** (a) | **23.** (d) | **24.** (c) | **25.** (d) | **26.** (b) |
| **27.** (a) | **28.** (c) | **29.** (d) | **30.** (c) | **31.** (c) | **32.** (c) | **33.** (c) | **34.** (c) | **35.** (b) | **36.** (c) | **37.** (e) | **38.** (a) | **39.** (d) |
| **40.** (d) | **41.** (e) | **42.** (a) | **43.** (c) | **44.** (a) | **45.** (a) | **46.** (b) | **47.** (c) | **48.** (c) | **49.** (a) | **50.** (c) | **51.** (b) | **52.** (a) |
| **53.** (b) | **54.** (b) | **55.** (c) | **56.** (a) | **57.** (b) | **58.** (a) | **59.** (b) | **60.** (a) | **61.** (c) | **62.** (b) | **63.** (d) | **64.** (c) | **65.** (c) |
| **66.** (b) | **67.** (c) | **68.** (d) | **69.** (b) | **70.** (a) | **71.** (a) | **72.** (d) | **73.** (d) | **74.** (b) | **75.** (a) | **76.** (b) | **77.** (d) | **78.** (b) |
| **79.** (d) | **80.** (d) | **81.** (b) | **82.** (d) | **83.** (c) | **84.** (c) | **85.** (b) | **86.** (c) | **87.** (b) | **88.** (d) | **89.** (c) | **90.** (a) | |

## EXPLANATORY ANSWERS

### Exercise–1

**1.** **(a)** Here, $X = 15$ and $Y = 12$.

$\therefore$ Working together, 10 men and 15 women will complete the work in

$$= \frac{XY}{X+Y} \text{ days}$$

$$= \frac{15 \times 12}{15+12}, \text{ i.e., } \frac{20}{3} \text{ or, } 6\frac{2}{3} \text{ days.}$$

**2.** **(b)** Here, $X = 30$ and $Y = 40$.

$\therefore$ A and B working together can do the work in

$$= \frac{XY}{X+Y} \text{ days.}$$

$$= \frac{30 \times 40}{30+40} \text{ days, i.e., } \frac{120}{7} \text{ or, } 17\frac{1}{7} \text{ days.}$$

**3.** **(b)** $A$ can do the complete work in $5 \times 3 = 15$ days.

B can complete the complete work in $10 \times \frac{5}{2} = 25$ days.

Here, $X = 15$ and $Y = 25$.

$\therefore$ A and B, working together, can complete the work in

$$= \frac{XY}{X+Y} \text{ days}$$

$$= \frac{15 \times 25}{15+25} \text{ days, i.e., } \frac{75}{8} \text{ or, } 9\frac{3}{8} \text{ days.}$$

**4.** **(c)** Here, $X = 6$, $Y = 12$ and $Z = 24$.

$\therefore$ Working together, A, B and C will complete the work in

$$= \frac{XYZ}{XY+YZ+ZX} \text{ days}$$

$$= \frac{6 \times 12 \times 24}{6 \times 12 + 12 \times 24 + 24 \times 6} \text{ days,}$$

i.e., $\frac{24}{7}$ days, or, $3\frac{3}{7}$ days.

**5.** **(b)** Let, B take $x$ days to do the work. Then, A takes $(x - 60)$ days to complete the work.

Since ratio of work done by A and B is 3:1, ratio of time taken by A and B is 1:3.

We have, $\frac{x-60}{x} = \frac{1}{3}$

$\Rightarrow$ $3(x - 60) = x$ or, $x = 90$.

$\therefore$ Time taken by B to complete the work = 90 days and time taken by A to complete the work = $\frac{90}{3}$ = 30 days.

$\therefore$ A and B, working together, will complete the work in

$$= \frac{XY}{X+Y} \text{ days}$$

$$= \frac{90 \times 30}{90 + 30} \text{ days, i.e., } \frac{45}{2}$$

or, $22\frac{1}{2}$ days.

**6.** **(c)** Let, Ramesh take $x$ days to complete the work.

Then, Mahesh takes $\frac{x}{2}$ and Suresh takes $\frac{x}{3}$ days to complete the same piece of work.

$\therefore$ Ramesh, Mahesh and Suresh, working together, will complete the work in

$$= \frac{XYZ}{XY + YZ + ZX} \text{ days} = \frac{x + \frac{x}{2} \times \frac{x}{3}}{x \times \frac{x}{2} + \frac{x}{2} \times \frac{x}{3} + x \times \frac{x}{3}} \text{ days}$$

i.e., $\frac{x^3/6}{x^2}$ or, $\frac{x}{6}$ days.

Given, $\frac{x}{6} = 4$.

$\therefore$ $x = 24$

$\therefore$ Ramesh takes 24 days, Mahesh takes $\frac{24}{2}$ or 12 days, and Suresh takes $\frac{24}{3}$ or 8 days to complete the work.

**7.** **(a)** Let, Gita takes $x$ days to complete the work. Then, Sita takes $2x$ days to complete the same piece of work.

$\therefore$ Time taken by Rita to complete the work

$$= \frac{XY}{X+Y} \text{ days}$$

$$= \frac{x \times 2x}{x + 2x} \text{ days, or, } \frac{2x}{3} \text{ days.}$$

$\therefore$ Working together, Gita, Sita and Rita will complete the work in

$$= \frac{XYZ}{XY + YZ + ZX} \text{ days}$$

$$= \frac{x \times 2x \times \frac{2x}{3}}{x \times 2x + 2x \times \frac{2x}{3} + \frac{2x}{3} \times x} \text{ days, or, } \frac{x}{3} \text{ days.}$$

Given, $\frac{x}{3} = 6$. $\therefore$ $x = 18$ days.

$\therefore$ Gita takes 18 days, Sita takes 36 days, and Rita takes 12 days to complete the work.

**8.** **(b)** 1 Man can complete the work in $5 \times 2 = 10$ days.
1 woman can complete the work in $4 \times 3 = 12$ days.
1 child can complete the work in $5 \times 3 = 15$ days.

$\therefore$ 1 man, 1 woman and 1 child, working together, can complete the work in

$$= \frac{XYZ}{XY + YZ + ZX} \text{ days}$$

$$= \frac{10 \times 12 \times 15}{10 \times 12 + 12 \times 15 + 15 \times 10} = 4 \text{ days.}$$

**9.** **(b)** Here, $X = 6$ and $Y = 9$.

$\therefore$ B alone will complete the work in = $\frac{XY}{Y - X}$ days

$= \frac{6 \times 9}{9 - 6}$, i.e., 18 days.

**10.** **(c)** Here, $X = 30$, $Y = 40$ and $Z = 60$.

$\therefore$ A, B and C together will finish the work in

$$= \left(\frac{2XYZ}{XY + YZ + ZX}\right) \text{ days}$$

$$= \left(\frac{2 \times 30 \times 40 \times 60}{30 \times 40 + 40 \times 60 + 60 \times 30}\right) \text{ days}$$

or, $\frac{144000}{5400}$, i.e., $26\frac{2}{3}$ days.

**11.** **(a)** Here, $X = 18$, $Y = 24$ and $Z = 36$.

$\therefore$ A alone can do the work in

$$= \left(\frac{2XYZ}{XY + YZ - ZX}\right) \text{ days}$$

$$= \left(\frac{2 \times 18 \times 24 \times 36}{18 \times 24 + 24 \times 36 - 36 \times 18}\right) \text{ days}$$

or, $\frac{31104}{648}$, i.e., 48 days.

**12.** **(b)** Ajay, Sunil and Sanjay, working together, can complete the work in

$$= \left(\frac{2XYZ}{XY + YZ + ZX}\right) \text{days}$$

$$= \left(\frac{2 \times 10 \times 15 \times 20}{10 \times 15 + 15 \times 20 + 20 \times 10}\right) \text{days}$$

or, $\frac{6000}{650}$, i.e., $\frac{120}{13}$ days.

$\therefore$ Work done by all of them together in 6 days

$$= 6 \times \frac{13}{120}, \text{ i.e., } \frac{13}{20}.$$

Also, work done by Sunil and Sanjay in 4 days = $\frac{4}{15}$.

$\therefore$ Remaining work = $1 - \left(\frac{13}{20} + \frac{4}{15}\right) = \frac{1}{12}$, which is to be done by Sanjay.

Now, Ajay, Sunil and Sanjay, can complete the work in $\frac{120}{13}$ days. Ajay and Sunil can complete the work in 10 days.

$\therefore$ Sanjay alone can complete the work in

$$= \frac{\frac{120}{13} \times 10}{10 - \frac{120}{13}} \text{ days} = 120 \text{ days.}$$

$\therefore$ $\frac{1}{12}$ of the work is done by Sanjay in $\frac{120}{12} = 10$ days.

**13.** **(c)** Since Anu can complete the work in 10 days, Manu can complete the work in $= 10 \times \frac{100}{125} = 8$ days. Also, Sonu can complete the work in $= 8 \times \frac{100}{160} = 5$ days.

$\therefore$ Anu, Manu and Sonu will complete the work in

$$= \frac{XYZ}{XY + YZ + ZX} \text{ days}$$

$$= \left(\frac{10 \times 8 \times 5}{10 \times 8 + 8 \times 5 + 5 + 10}\right) \text{ days}$$

or, $\frac{400}{170}$, i.e., $2\frac{6}{17}$ days.

**14.** **(a)** C alone will finish the job in

$$= \frac{XY}{Y - X} \text{ days} = \frac{8 \times 12}{12 - 8} \text{ days}$$

[Here, $X = 8$ and $Y = 12$]

= 24 days.

**15.** **(b)** Bansal, Gupta and Singhal together can finish the work in 4 days.

Bansal and Gupta together can do it in $\frac{24}{5}$ days.

Gupta and Singhal together can do it in 8 days. Therefore, Bansal alone can complete the work in

$$= \frac{XY}{Y - X} \text{ days}$$

$$= \left(\frac{8 \times 4}{8 - 4}\right) \text{ days}$$

[Here, $X = 4$ and $Y = 8$]

= 8 days.

Also, Singhal alone can complete the work in

$$= \left(\frac{XY}{Y - X}\right) \text{ days} = \left(\frac{\frac{24}{5} \times 4}{\frac{24}{5} - 4}\right) \text{days}$$

$$\left[\text{Here, } X = 4 \text{ and } Y = \frac{24}{5}\right]$$

= 24 days.

$\therefore$ Bansal and Singhal can complete the work in

$$= \left(\frac{XY}{X + Y}\right) \text{days} = \left(\frac{24 \times 8}{24 + 8}\right) \text{days}$$

[Here, $X = 24$ and $Y = 8$]

= 6 days.

$\therefore$ Gupta alone can complete the work in

$$= \left(\frac{XY}{Y - X}\right) \text{days} = \left(\frac{4 \times 6}{6 - 4}\right) \text{days}$$

[Here, $X = 4$ and $Y = 6$]

= 12 days.

**16.** **(c)** Nishita and Kavita complete the work in 4 days and Nishita alone does it in 6 days.

$\therefore$ Kavita alone can do the work in

$$= \left(\frac{XY}{Y - X}\right) \text{days} = \left(\frac{4 \times 6}{6 - 4}\right) \text{days}$$

[Here, $X = 4$ and $Y = 6$]

= 12 days.

$\therefore$ Nikita and Nishita can complete the work in

$$= \left(\frac{XY}{Y - X}\right) \text{days} = \left(\frac{\frac{8}{3} \times 12}{12 - \frac{8}{3}}\right) \text{days}$$

$$\left[\text{Here, } X = \frac{8}{3} \text{ and } Y = 12\right]$$

$$= \frac{96}{28} = 3\frac{3}{7} \text{ days.}$$

**17.** **(b)** Here, $X = 14$ and $K = 2$.

$\therefore$ A alone can finish the work in

$$= \left(\frac{K + 1}{K}\right) X \text{ days} = \left(\frac{2 + 1}{2}\right) 14 \text{ days, i.e., 21 days.}$$

**18.** **(a)** Here, $X = 10$ and $K = 2$.

$\therefore$ The time taken by Bindal and Jindal, working together, to complete the work

$$= \frac{X}{1 + K} = \frac{10}{1 + 2}, \text{ i.e., } \frac{10}{3}, \text{ or, } 3\frac{1}{3} \text{ days.}$$

**19.** **(b)** Here, $a = 27$ and $b = 3$.

$\therefore$ Time taken by A and B, working together, to complete the job

$= \sqrt{ab}$ days $= \sqrt{27 \times 3}$, or, 9 days.

**20.** **(a)** Here, $k = 4$ and $l = 45$.

Therefore, A and B, working together, can complete the work in

$$= \frac{kl}{k^2 - 1} \text{ days} = \frac{4 \times 45}{16 - 1} \text{ days, i.e., 12 days.}$$

**21.** **(c)** Here, $a = 1$, $b = 1$, $X = 16$, $c = 3$ and $d = 4$.

Therefore, number of days required to complete $\frac{3}{4}$ of the work

$$= \frac{b \times c \times X}{a \times d} = \frac{1 \times 3 \times 16}{1 \times 4} = 12 \text{ days.}$$

**22.** **(a)** We have, $M_1 = 24$, $D_1 = 27$, $W_1 = 1$, $t_1 = 7$

$M_2 = 14$, $D_2 = ?$, $W_2 = 1$, $t_2 = 9$

$\therefore \quad M_1D_1t_1W_2 = M_2D_2t_2W_1$

$\Rightarrow \quad 24 \times 27 \times 7 \times 1 = 14 \times D_2 \times 9 \times 1$

$\Rightarrow \quad D_2 = 36$ days.

**23. (b)** We have, $M_1 = 10$, $D_1 = 2$, $W_1 = 15$

$M_2 = 10 - 2 = 8$, $D_2 = 3$, $W_2 = ?$

$\therefore \quad M_1D_1W_2 = M_2D_2W_1$

$\Rightarrow \quad 10 \times 2 \times W_2 = 8 \times 3 \times 15$

$\Rightarrow \quad W_2 = 18$ trees.

Thus, 18 trees will be cut in 3 hours.

**24. (a)** We have, $M_1 = 45$, $D_1 = 30$, $t_1 = 12$, $W_1 = 1$

$M_2 = 60$, $D_2 = ?$, $t_2 = 10$, $W_2 = 1$

$\therefore \quad M_1D_1t_1W_2 = M_2D_2t_2W_1$

$\Rightarrow \quad 45 \times 30 \times 12 \times 1 = 60 \times D_2 \times 10 \times 1$

$\Rightarrow \quad D_2 = 27$ days.

**25. (b)** Given, 8 women = 6 Men = 12 Boys

$\therefore$ 12 Men + 12 Women + 12 Boys

= 12 Men + 9 Men + 6 Men = 27 Men

We have, $M_1 = 9$, $D_1 = 6$, $t_1 = 6$, $W_1 = 1$

$M_2 = 27$, $D_2 = ?$, $t_2 = 8$, $W_2 = 1$

$\therefore \quad M_1D_1t_1W_2 = M_2D_2t_2W_1$

$\Rightarrow \quad 9 \times 6 \times 6 \times 1 = 27 \times D_2 \times 8 \times 1$

$\Rightarrow \quad D_2 = \frac{3}{2}$ days, or, $1\frac{1}{2}$ days.

**26. (b)** Here, $a = 4$, $b = 6$, $n = 20$, $c = 6$ and $d = 11$.

$\therefore$ Required number of days

$= \left(\frac{nab}{bc + ad}\right)$ days $= \left(\frac{20 \times 4 \times 6}{6 \times 6 + 4 \times 11}\right)$ days

= 6 days.

**27. (b)** Here, $a = 10$, $b = 12$, $n = 10$, $c = 15$ and $d = 6$.

$\therefore$ Required number of days

$= \left(\frac{nab}{bc + ad}\right)$ days

$= \left(\frac{10 \times 10 \times 12}{12 \times 15 + 10 \times 6}\right)$ days

= 5 days.

**28. (b)** (A + B)'s 5 day's work $= 5\left(\frac{1}{10} + \frac{1}{15}\right) = \frac{5}{6}$

Remaining work $= 51 - \frac{5}{6} = \frac{1}{6}$

$\therefore$ C's 2 days' work $= \frac{1}{6}$

Now, A's 5 days' work:B's 5 days' work

$\therefore$ C's 2 days' work $= \frac{5}{10} : \frac{5}{15} : \frac{1}{6} = 3:2:1$

$\therefore$ A's share = ₹$\left(450 \times \frac{3}{6}\right)$ = ₹225

B's share = ₹$\left(450 \times \frac{2}{6}\right)$ = ₹150

C's share = ₹[450 − (225 + 150)] = ₹75

**29. (b)** Wages of the first man for 3 days

= work done by him in 3 days × ₹1400

$= \frac{3}{7} \times 1400$ = ₹600

Wages of second man for 3 days

= work done by him in 3 days × ₹1400

$= \frac{3}{8} \times 1400$ = ₹525

$\therefore$ Wages of the boy for 3 days

= ₹1400 − ₹(600 + 525) = ₹275

$\therefore$ Their shares will be ₹600, ₹525 and ₹275, respectively.

**30. (a)** Suppose, B takes $x$ days to do the work

$\therefore$ A takes $\left(2 \times \frac{3}{4}x\right)$, i.e., $\frac{3x}{2}$ days to do it.

Now, (A + B)'s 1 day's work $= \frac{1}{18}$

$\therefore \quad \frac{1}{x} + \frac{2}{3x} = \frac{1}{18}$, or, $x = 30$.

**31. (a)** A's 1 days' work $= \frac{1}{30}$

B's 1 days' work $= \frac{1}{40}$

$\therefore$ Share of A and B should be in the ratio

$\frac{1}{30} : \frac{1}{40} = 4:3$

$\therefore$ B's share = ₹$\left(\frac{3}{7} \times 2100\right)$ = ₹900.

**32. (c)** The first man's 3 days' work $= \frac{3}{6} = \frac{1}{2}$

The second man's 3 days' work $= \frac{3}{8}$

The boy's 3 days' work $= 1 - \left(\frac{1}{2} + \frac{3}{8}\right) = \frac{1}{8}$

$\therefore$ They should get money in the ratio

$\frac{1}{2} : \frac{3}{8} : \frac{1}{8}$ i.e., 4:3:1

$\therefore$ The boy's share = ₹$\frac{1}{8} \times 600$ = ₹75.

**33. (a)** (A + B)'s 1 day's work $= \frac{1}{6}$

A's 1 days' work $= \frac{1}{8}$

$\therefore$ B's 1 days' work $= \frac{1}{6} - \frac{1}{8} = \frac{1}{24}$

$\therefore$ Money should be divided in the ratio

$\frac{1}{8}:\frac{1}{24} = 3:1$

$\therefore$ B gets = ₹$\left(\frac{1}{4}\times 320\right)$ = ₹80.

**34.** **(b)** Obviously,

$(5M + 2B) = 4(1M + 1B)$

$\therefore$ $M = 2B$

$\therefore$ Work done by a man and a boy are in the ratio 2:1.

**35.** **(d)** (A + B + C)'s 1 day's work

$$= \frac{1}{16}+\frac{1}{32}+\frac{1}{48}=\frac{11}{96}$$

Work done in first 4 days = $\frac{11}{96} \times 4 = \frac{11}{24}$

For last two days, A works alone

$\therefore$ Work done in last 2 days = $\frac{1}{16}\times 2=\frac{1}{8}$

Rest of the work i.e.,$\left(1-\frac{11}{24}-\frac{1}{8}=\frac{5}{12}\right)$ is done by A and B together.

(A + B)'s 1 day's work = $\frac{1}{16}+\frac{1}{32}=\frac{3}{32}$

$\therefore$ $\frac{5}{12}$ work is finished in $\frac{32}{3}\times\frac{5}{12}=\frac{40}{9}$ days

$\therefore$ Total number of days in which the whole work is finished = $4+2+\frac{40}{9}=10\frac{4}{9}$ days.

**36.** **(b)** (A + B)'s 2 days' work = $\frac{1}{9}+\frac{1}{12}=\frac{7}{36}$

Evidently, the work done by A and B during 5 pairs of days

$$= 5\times\frac{7}{36}=\frac{35}{36}$$

Remaining work = $1-\frac{35}{36}=\frac{1}{36}$.

Now, on 11th day, it is A's turn

Now, $\frac{1}{9}$ work is done by A in 1 day

$\therefore$ $\frac{1}{36}$ work will be done by A in $9\times\frac{1}{36}=\frac{1}{4}$ day.

So, total time taken = $10\frac{1}{4}$ days.

**37.** **(c)** B's 23 days' work = $\frac{23}{40}$

Remaining work = $1-\frac{23}{40}=\frac{17}{40}$

Now, (A + B)'s 1 day's work = $\frac{1}{45}+\frac{1}{40}=\frac{17}{360}$

$\frac{17}{360}$ work is done by A and B in 1 day.

$\therefore$ $\frac{17}{40}$ work is done by A and B in $\frac{360\times 17}{17\times 40}$ = 9 days

So, A left after 9 days.

**38.** **(b)** Suppose, C alone can do this work in $x$ days

$\therefore$ C will do $\frac{1}{x}$ work in 1 day

Now, work done by (B + C) in 1 day = $\frac{1}{16}$.

$\therefore$ Work done by B in 1day = $\left(\frac{1}{16}-\frac{1}{x}\right)$.

And, work done by (A + B) in 1 day = $\frac{1}{12}$.

$\therefore$ Work done by A in 1 day = $\frac{1}{12}-\left(\frac{1}{16}-\frac{1}{x}\right)$

$$= \frac{1}{48}+\frac{1}{x}$$

As per the to question,

Work done by A in 5 days + work done by B in 7 days + work done by C in 13 days = whole work

$\therefore$ $5\left(\frac{1}{48}+\frac{1}{x}\right)+7\left(\frac{1}{16}-\frac{1}{x}\right)+\frac{13}{x} = 1$

or, $\frac{5}{48}+\frac{5}{x}+\frac{7}{16}-\frac{7}{x}+\frac{13}{x} = 1$

or, $\frac{26}{48}+\frac{11}{x} = 1$, or, $\frac{11}{x}=1-\frac{26}{48}$

or, $\frac{11}{x}=\frac{22}{48}$, or, $x = 24$

$\therefore$ C alone would complete this work in 24 days.

**39.** **(a)** Work done by A in 5 days = $\frac{5}{40}=\frac{1}{8}$.

$\therefore$ Remaining work = $1-\frac{1}{8}=\frac{7}{8}$.

$\therefore$ B completes $\frac{7}{8}$ work in 21 days.

$\therefore$ B would complete one work in $\frac{21\times 8}{7}$ = 24 days.

Here, $x = 40$, $y = 24$.

$\therefore$ Working together, A and B would complete this work in

$= \frac{xy}{x+y}=\frac{40\times 24}{40+24}=\frac{40\times 24}{64}$ = 15 days.

**40.** **(a)** (A + B)'s 1 day's work $= \frac{1}{30} + \frac{1}{50} = \frac{8}{150}$.

$\therefore$ (A + C)'s 1 day's work $= \frac{1}{30} + \frac{1}{40} = \frac{7}{120}$.

$\therefore$ Work done in first two days $= \frac{8}{150} + \frac{7}{120} = \frac{67}{600}$.

Work done in $8 \times 2 = 16$ days $= \frac{67 \times 8}{600} = \frac{67}{75}$.

Work left $= 1 - \frac{67}{75} = \frac{8}{75}$.

On the 17th day, (A + B) will work and they will complete $\frac{8}{150}$ work.

$\therefore$ Work left $= \frac{8}{75} - \frac{8}{150} = \frac{8}{150} = \frac{4}{75}$.

On the 18th day, (A + C) will work and they will finish it in $\frac{120}{7} \times \frac{4}{75} = \frac{32}{35}$ days.

$\therefore$ The whole work will be done in $17\frac{32}{35}$ days.

## Exercise–2
## (Based on Memory)

**1.** **(b)** Required number of days $= 24\left(\frac{56}{42}\right) = 32$

**2.** **(c)** Required number of hours $= \frac{4 \times 2 \times 10 \times 5}{2 \times 1 \times 20}$

$= 10$ hours

**3.** **(c)** Work of A for 1 day $= \frac{1}{2}$

Work of (A + B) for 1 day $= \frac{1}{8}$

$\therefore$ Work of B for 1 day $= \frac{1}{8} - \frac{1}{12} = \frac{1}{24}$

$\therefore$ B alone can complete the same work in 24 days

**4.** **(d)** Since work done by children in a day is not given (directly or indirectly) we cannot get the required value.

**5.** **(c)** Required men $= 15\left(\frac{6}{7.5}\right) = 12$

**6.** **(c)** A does the work in 8 days.

B does the work in 16 days.

$\therefore$ A + B do the work in $\frac{8 \times 16}{8 + 16} = \frac{16}{3} = 5\frac{1}{3}$ days

**7.** **(d)** We have $24 \times 16$ men $= 8 \times 72$ women

$= 24 \times 32$ children

$\Rightarrow 2$ men $= 3$ women $= 4$ children

Now, 10 men + 15 women + 24 children

$= 10$ men $+ 15\left(\frac{2}{3}\right)$ men $+ 24\left(\frac{2}{4}\right)$ men $= 32$ men

$\therefore$ required number of days $= \frac{24 \times 16}{32} = 12$ days

**8.** **(d)** From the given information we get

Work done by $(8 \times 12)$ men

$= (4 \times 48)$ women $= (10 \times 24)$ children

i.e., work done by

1 man = 2 women = 2.5 children

Now, the required time to finish the work

$= \frac{10 \times 24}{10 \times 2.5 + 4 \times 2.5/2 + 10} = \frac{10 \times 14}{40} = 6$ days

**9.** **(a)** Suppose the work consists of making 12 pillars. Since 'A' can complete the work in 12 days, this implies that 'A' can make one pillar in a day. Similarly, we get that 'A' and 'B' together can make three pillars in a day. Hence we can conclude that 'B' can make two pillars in a day. Hence, the total work (12 pillars) can be completed by 'B' in $(12 \div 2 =)$ 6 days.

**10.** **(b)** From the given information, we get

$9 \times 360$ children or $18 \times 72$ men or $12 \times 162$ women can finish the work in one day.

Hence we get

Efficiency of 2 men = efficiency of 3 women

= efficiency of 5 children

Hence, the required number of days to finish the work

$= \frac{9 \times 360}{5/2 \times 4 + 5/3 \times 12 + 10} = \frac{9 \times 360}{40} = 81$ days

**11.** **(c)** (A + B)'s one day's work $= \frac{1}{8}$

(B + C)'s one day's work $= \frac{1}{6}$

(C + A)'s one day's work $= \frac{1}{10}$

$\therefore$ (A + B + C)'s one day's work

$= \frac{1}{2}\left[\frac{1}{8} + \frac{1}{6} + \frac{1}{10}\right]$

$= \frac{1}{2}\left[\frac{15 + 20 + 12}{120}\right] = \frac{47}{240}$

$\therefore$ A, B and C together can finish the whole work in $\frac{240}{47} = 5\frac{5}{47}$ days

**12. (b)** Let the original number of workers be $x$.

$\therefore$ $x$ workers can do the work in 100 days

$(x - 10)$ workers can do the work in 110 days

$\Rightarrow$ $100x = 110(x - 10)$

$\Rightarrow$ $10x = 1100 \Rightarrow x = 110$

**13. (d)** (A + B)'s one day's work $= \frac{1}{12}$

(B + C)'s one day's work $= \frac{1}{8}$

(C + A)'s one day's work $= \frac{1}{6}$

$\therefore$ (A + B + C)'s one day's work

$$= \frac{1}{2}\left[\frac{1}{6}+\frac{1}{8}+\frac{1}{12}\right] \quad \cdots(1)$$

$$= \frac{1}{2}\left[\frac{8+6+4}{48}\right] = \frac{9}{48} \quad \cdots(2)$$

(1) and (2) $\Rightarrow$ B's one day's work

$= \frac{9}{48} - \frac{1}{6} = \frac{1}{48}$

$\therefore$ B alone can finish the whole work in 48 days.

**14. (d)** 1 man = 3 boys

[Given]: Wages for five days = ₹800

$\therefore$ Wages for one day $= \frac{800}{5}$ = ₹160

The wages of ₹160 are to be divided among the man and boy in the ratio 1:3.

$\therefore$ Wages of the boy per day

$= \frac{1}{4} \times 160$ = ₹40

**15. (c)** A does $\frac{7}{10}$ in 15 days.

$\Rightarrow$ A alone can do the whole work in $\frac{150}{7}$ days.

$\Rightarrow$ A's one day's work $= \frac{7}{150}$

A and B together can do $\frac{3}{10}$ of the work in 4 days.

$\therefore$ A and B together can complete the work in $\frac{40}{3}$ days.

$\Rightarrow$ (A + B)'s one day's work $= \frac{3}{40}$

$\therefore$ B's one day's work $= \frac{3}{40} - \frac{7}{150}$

$$= \frac{45-28}{600} = \frac{17}{600}$$

$\therefore$ (A + B)'s one day's work

$$= \frac{7}{150} + \frac{17}{600} = \frac{45}{600} = \frac{3}{40}$$

$\Rightarrow$ A and B together can finish the whole work in $\frac{40}{3} = 13\frac{1}{3}$ days.

**16. (a)** Woman's one day's work

$= \frac{1}{3} - \frac{1}{6} - \frac{1}{18} = \frac{6-3-1}{18} = \frac{1}{9}$.

**17. (b)** $(A + B + C)$ will do the same piece of work in

$$\frac{10\times 15\times 20\times 2}{10\times 15 + 15\times 20 + 20\times 10} = \frac{120}{13} \text{ days.}$$

**18. (c)** 'A' can cultivate full part of the land in $\frac{6\times 5}{2}$ days.

'B' can cultivate full part of the land in $(10 \times 3) = 30$ days.

Hence, the required time to do $\frac{4}{5}$ part when 'A' and 'B' work together $= \left(\frac{15\times 30}{30+15}\right) \times \frac{4}{5} = 8$ days.

**19. (c)** Efficiency of A is three times that of B. Hence, time required to finish the work by

B (alone) $= (3 + 1) \times 10 = 40$ days.

**20. (b)** A can do a piece of work in 4 hours

A and C can do it in 2 hours.

$\therefore$ C alone can do it in $\left(\frac{4\times 2}{4-2} = 4\right)$ hours

B and C can do it in 3 hours.

$\therefore$ B alone can do it in $\left(\frac{4\times 3}{4-3} = 12\right)$ hours.

**21. (a)** A does the whole work in $\frac{5}{4} \times 20 = 25$ days.

Remaining work $\left(1 - \frac{4}{5}\right) = \frac{1}{5}$, is done by A and B in 3 days.

$\therefore$ Whole work is done by A and B in $(5 \times 3 = 15)$ days.

$\therefore$ B alone can do the whole work in $\left(\frac{25\times 15}{25-15}\right) = 37\frac{1}{2}$ days.

**22. (a)** $\frac{18+9}{18\times 9} = \frac{1}{6}$.

**23. (d)** (A + B)'s one day's work $= \frac{1}{30}$

(B + C)'s one day's work $= \frac{1}{15}$

(C + A)'s one day's work $= \frac{1}{10}$

$\therefore$ 2(A + B + C)'s one day's work

$$= \frac{1}{30} + \frac{1}{15} + \frac{1}{10} = \frac{1+2+3}{30} = \frac{1}{5}$$

$\therefore$ (A + B + C)'s one day's work $= \frac{1}{10}$.

**24. (c)** A can finish the work in 40 days.

B can finish the work in 100 days.

C can finish the work in 39 days.

**25.** **(d)** (A + B + C)'s one day's work = $\frac{1}{2}$

Let C can finish the work in $x$ days.

$\therefore$ A can finish the work in $3x$ days.

$\Rightarrow$ B can finish the work in $\frac{3x}{2}$ days.

$\therefore$ (A + B + C)'s one day's work = $\frac{1}{3x}+\frac{2}{3x}+\frac{1}{x}$

$\therefore$ $\frac{1}{3x}+\frac{2}{3x}+\frac{1}{x}=\frac{1}{2}$

$\Rightarrow$ $\frac{3x}{2} = 6$

$\Rightarrow$ $x = 4$

$\therefore$ B alone can do the whole work in 6 days.

**26.** **(b)** A and B together do $\frac{20}{30}=\frac{2}{3}$ part of the work in 20 days.

Remaining work = $1-\frac{2}{3}=\frac{1}{3}$

$\therefore$ A alone can do the work in 20 × 3 = 60 days.

**27.** **(a)** Required number of men

$$= 72\times\frac{21}{18}\times\frac{100}{280} = 30.$$

**28.** **(c)** Ratio of the efficiencies of

Babu : Asha

4 : 7

Ratio of the no. of days taken by Babu and Asha to complete the job = 7:4

Also, $\frac{28x^2}{11x} = 7$ or, $x = \frac{11}{4}$

$\therefore$ Asha alone can do the work in $4\times\frac{11}{4} = 11$ days.

**29.** **(d)** 3 M = 4 W

$7\text{M} + 5\text{W} = 7\text{M} + \frac{5\times 3\text{M}}{4} = 7\text{M}+\frac{15\text{M}}{4}=\frac{43\text{M}}{4}$

$\because$ 3 men plough a field in 43 days

$\therefore$ $\frac{43}{4}$ men plough a field in $\frac{43\times 3\times 4}{43} = 12$ days.

**30.** **(c)** Part of the work done by 8 men in 6 days

$$= \frac{6}{12} = \frac{1}{2}$$

Remaining work = $1-\frac{1}{2}=\frac{1}{2}$

Required number of days = $\frac{1}{2}\times 8 = 4$ days.

**31.** **(c)** Part of work done by B and C in 3 days

$$= 3\left(\frac{1}{9}+\frac{1}{12}\right)=\frac{7}{12}$$

Remaining work = $1-\frac{7}{12}=\frac{5}{12}$

Remaining work is done by A in = $\frac{5}{12}\times 24 = 10$ days.

**32.** **(c)** C alone can do the work in

$\frac{1}{4}-\left(\frac{1}{8}+\frac{1}{12}\right)=\frac{1}{4}-\frac{5}{24}=\frac{6-5}{24}=\frac{1}{24}$

i.e., 24 days

Ratio of their wages = $\frac{1}{8}:\frac{1}{12}:\frac{1}{24} = 3:2:1$

C's share = $\frac{1}{6}\times 4500 =$ ₹750.

**33.** **(c)** Required sum = $8400\times\frac{6}{8}\times\frac{9}{6} =$ ₹9450.

**34.** **(c)** A, B and C together can do the work in

$= \frac{10\times 50}{60}=\frac{25}{3}$ days.

Suppose, A alone could do it in '$x$' days.

Then, (B + C) together can also do it in '$x$' days

i.e., $\frac{x\times x}{2x} = \frac{25}{3}$

$\Rightarrow$ $x = \frac{50}{3}$ days

$\therefore$ B alone can do it in $\frac{1}{10}-\frac{3}{50} = \frac{5-3}{50}=\frac{1}{25}$

i.e., 25 days.

**35.** **(b)** 24 men complete the work in 16 days.

$\therefore$ 16 men complete $\left(\frac{16}{24}\times\frac{12}{16}\right)=\frac{1}{2}$ part of work in 12 days.

32 women complete the work in 24 days.

$\therefore$ 16 women complete $\frac{16}{32}\times\frac{14}{24}=\frac{7}{24}$ part of work in (12 + 2) = 14 days.

So, the remaining part of the work which is done by 16 men + 16 women and the required additional no. of men in 2 days

$$= 1-\left(\frac{1}{2}+\frac{7}{24}\right)=\frac{1}{2}-\frac{7}{24}=\frac{5}{24} \text{ (Part)}$$

Now, in 2 days $\frac{5}{24}$ part of work is done by

$24\times\frac{16}{2}\times\frac{5}{24} = 40$ men

Hence, the required no. of men = 40 − 16 = 24.

**36.** **(c)** 10 men + 15 women in 1 day do $\frac{1}{15}+\frac{1}{12}=\frac{9}{60}$ work

$\therefore$ Time taken = $\frac{60}{9}$ days = $\frac{2}{3}$ days.

**38.** **(a)** Work done by 'A' in 3 days = $\frac{1}{12}\times 3=\frac{1}{4}$

$\therefore$ Remaining work = $1-\frac{1}{4}=\frac{3}{4}$

Work done by A and B together = $\frac{12\times 15}{27}=\frac{20}{3}$ days

$\therefore$ Remaining work is done by A and B together in

$$=\frac{3}{4}\times\frac{20}{3} = 5 \text{ days.}$$

**40.** **(d)** $\because$ $8W = 6M = 12B$

$\therefore$ $12M + 12W + 12B \Rightarrow 12M + 9M + 6M = 27M$

$\because$ 9 men can complete the work working 1 hour per day in $6 \times 6$ days

$\therefore$ 27 men working 8 hours per day

$$=\frac{6\times 6\times 9}{27\times 8}=1\frac{1}{2} \text{ days.}$$

**41.** **(e)** $\because$ $M = 2B$

$\therefore$ $7M + 4B = 14B + 4B = 18B$

and $5M + 4B = 10B + 4B = 14B$

$\because$ 18 boys complete the work in 6 days

$\therefore$ 14 boys complete the work in = $\frac{6\times 18}{14}=7\frac{5}{7}$ days.

**42.** **(a)** The part of job that Vinod completes in 9 hours $=\frac{9}{15}=\frac{3}{5}$

Remaining job = $1-\frac{3}{5}=\frac{2}{5}$

Remaining job can be done by Vinay in $\frac{2}{5}\times 10 = 4$ hours.

**43.** **(c)**

| Work | Days | Men |
|---|---|---|
| 1 | 12 | 7 |
| 2 ↓ | 8 ↓ | $x$ ↓ |

Therefore,

1:2::7:$x$ 8:12

$\Rightarrow$ $1 \times 8 \times x = 2 \times 12 \times 7$

$8x = 168$

$$x = \frac{168}{8} = 21$$

Hence, number of additional men

$= 21 - 7 = 14$

**44.** **(a)** If $X$ can complete the work in $a$ days then

$3a - a = 40 \rightarrow a = 20$

$\therefore$ Work done by $(X + Y)$ for

1 day $\frac{1}{20}+\frac{1}{60} = \frac{4}{60} = \frac{1}{15}$

$\therefore$ $X$ and $Y$ together will complete the work in 15 days.

**45.** **(a)** Work done by A for 3 days = $\frac{3}{12} = \frac{1}{4}$

$\therefore$ Remaining work = $1-\frac{1}{4} = \frac{3}{4}$

$\therefore$ Work done by (A + B) for 1 day = $\frac{3}{4}\times\frac{1}{3} = \frac{1}{4}$

$\therefore$ Work done by B for 1 day = $\frac{1}{4}-\frac{1}{12} = \frac{2}{12} = \frac{1}{6}$

$\therefore$ B alone will complete the work in 6 days.

**46.** **(b)** Let the number of days taken by A to complete the work be $x$ days.

Therefore, days taken by B to complete the same $= 3x$ days.

So, $3x - x = 60$

$\Rightarrow$ $2x = 60$

$\Rightarrow$ $x = 30$

and $3x = 3 \times 30 = 90$

Therefore, (A + B)'s 1 day's work

$= \frac{1}{30}+\frac{1}{90} = \frac{3+1}{90} = \frac{4}{90} = \frac{2}{25}$

Hence, A and B together will do the work in

$\frac{45}{2} = 22\frac{1}{2}$ days.

**47.** **(c)** (P + Q)'s 1 day's work = $\frac{1}{12}$ ...(1)

(Q + R)'s 1 day's work = $\frac{1}{15}$ ...(2)

(R + P)'s 1 day's work = $\frac{1}{20}$ ...(3)

Adding equations (1), (2) and (3), we get

2(P + Q + R)'s 1 day's work

$= \frac{1}{12}+\frac{1}{15}+\frac{1}{20} = \frac{5+4+3}{60}$

$= \frac{12}{60} = \frac{1}{5}$

$\therefore$ (P + Q + R)'s 1 day's work

$= \frac{1}{10}$ ...(4)

Therefore, P's 1 day's work on subtracting Eq. 4 from Eq. 2, we get

$= \frac{1}{10}-\frac{1}{15} = \frac{3-2}{30} = \frac{1}{30}$

Hence, P will take 30 days to complete the work.

**48.** **(c)**

| Men | Days |
|---|---|
| $x$ | 30 |
| $x+6$ ↑ | 20 ↓ |

$x + 6$:$x$::30:20

$\Rightarrow$ $\frac{x+6}{x} = \frac{30}{20} = \frac{3}{2}$

$\Rightarrow \quad 2(x + 6) = 3x$

$\Rightarrow \quad 2x + 12 = 3x$

$\Rightarrow \quad 3x - 2x = 12$

$\Rightarrow \quad x = 12$ men

**49.** **(a)** Let, the number of days taken by B to complete the work be $x$.

Therefore, number of days taken by A to complete the work

$$= \frac{3x}{4} = \frac{1}{2}$$

Then time taken by A to complete the work

$$= 2 \times \frac{3x}{4} = \frac{3x}{2} \text{ days}$$

Thus, (A + B)'s 1 day's work

$= \frac{1}{x} + \frac{2}{3x} = \frac{3+2}{3x} = \frac{5}{3x}$

$\Rightarrow \quad \frac{5}{3x} = \frac{1}{18}$

$\Rightarrow \quad 3x = 90$

$\Rightarrow \quad x = \frac{90}{3} = 30$

Hence, time taken by B to complete the work = 30 days.

**50.** **(c)** Portion of work done by A and B in first in two days

$= \frac{1}{9} + \frac{1}{12} = \frac{4+3}{36} = \frac{7}{36}$

Portion of work done in the first 10 days = $\frac{35}{36}$

Remaining work = $\frac{1-35}{36} = \frac{36-35}{36} = \frac{1}{36}$

Therefore, time taken by

A = $\frac{1}{36} \times 9 = \frac{1}{4}$ day

Hence, total time = $10 + \frac{1}{4}$

$= \frac{40+1}{4} = \frac{41}{4} = 10\frac{1}{4}$ days

**51.** **(b)** Let, the daily wage earner absents $x$ days, then as per the question,

$60 \times 150 - 175 \times x = 7600$

$\Rightarrow \quad 9000 - 175x = 7600$

$\Rightarrow \quad 175x = 1400$

$\therefore \quad x = 8$

Hence, the daily wage earner worked for 52 days.

**52.** **(a)** Males : Females : Children

$6 \times 12:8 \times 18:18 \times 10$

72:144:180

2:4:5

So, 2 Males = 4 Females = 5 Children

4 Males + 12 Females + 20 Children

= 4 + 6 + 8 = 18 Males

$\because$ 6 males finished a piece of work in 12 days.

$\therefore$ 18 males finished the work = $\frac{12 \times 6}{18}$ = 4 days

Work in 2 days = $\frac{2}{4} = \frac{1}{2}$

Rest of the work will be finished in a day by

$= 18 \times 2 = 36$ males

**53.** **(b)** $2M = 3W$

$\therefore \quad 1M = \frac{3}{2}W$

$\therefore \quad 1M + 1W = \frac{3}{2}W + 1W = \frac{5}{2}W$

Number of days = $\frac{3 \times 4}{5/2} = \frac{24}{5}$ days

**54.** **(b)** $(8 \times 4)$ girls = $(9 \times 3)$ boys = $(7 \times 2)$ men = $(5 \times 4)$ Women

$\Rightarrow$ 32 girls = 27 boys = 14 men = 20 women

Hence, girls have minimum capacity of work among them.

**55.** **(c)** Suppose, A does a work in $x$ days.

B does similar work in $\frac{x}{2}$ days and C does in $\frac{x}{4}$ days.

$\because \quad \frac{x}{4} = \frac{7}{1}$

$\Rightarrow \quad x = 4 \times 7$

$x = 28$

$\because \quad \frac{1}{28} + \frac{1}{14} + \frac{1}{7} = \frac{1+2+4}{28}$

$$= \frac{7}{28} = \frac{1}{4}$$

So, A, B and C together will complete the work in 4 days.

**56.** **(a)** 1 male = 2 females

8 males and 4 females = 20 females

After 2 days, 4 males have left the work and 4 new females joined as their replacement = 4 males + 8 females

= 8 + 8 females

= 16 females

$M_1 = 20$ females

$D_1 = 6 - 2 = 4$ days

$M_2 = 16$ females

$D_2 = ?$

$M_1D_1 = M_2D_2$

$20 \times 4 = 16 \times D_2$

$D_2 = \frac{20 \times 4}{16}$

$D_2 = 5$ days

**57.** **(b)** B and C together can complete a work in = $\frac{1}{8}$

A and B together can complete a work in = $\frac{1}{12}$

A and C together can complete a work in = $\frac{1}{16}$

Work completed by 2(A + B + C) in a day

$= \frac{1}{8} + \frac{1}{12} + \frac{1}{16}$

$= \frac{6+4+3}{48} = \frac{13}{48}$

Work completed by (A + B + C) in day

$= \frac{13}{48\times 2} = \frac{13}{96}$

So, A, B and C together can complete the work in $\frac{96}{13}$ days $= 7\frac{5}{13}$ days.

**58.** **(a)** 8 × 20 men = 8 × 32 women

5 men = 8 women

Now, 5 men + 8 women = 8 + 8 = 16 women

$D_1 \times M_1 = M_2 \times D_2$

8 × 32 women = 16 × $D_2$

$D_2 = \frac{32\times 8}{16}$

= 16 days

**59.** **(b)** Work done for B

$= 1 - \frac{19}{23} = \frac{23-19}{23} = \frac{4}{23}$

$\therefore\ (A+C):B = \frac{19}{23}:\frac{4}{23} = 19:4$

$\therefore$ Sum of ratios = 19 + 4 = 23

$\therefore$ B's share $= \frac{4}{23}\times 575 = ₹100$

**60.** **(a)** According to the question,

1 man = 2 women = 4 boys

$\therefore$ 1 man + 1 woman + 1 boy

= (4 +2 + 1) boys = 7 boys

$\therefore\ M_1D_1 = M_2D_2$

$\Rightarrow\ 7\times 7 = 1\times D_2 \iff D_2 = 49$ days

**61.** **(c)** Remaining work $= 1 - \frac{1}{8} = \frac{7}{8}$

(A + B)'s 1 day's work $= \frac{1}{6} + \frac{1}{12} = \frac{2+1}{12} = \frac{3}{12} = \frac{1}{4}$

$\therefore$ Time taken in doing $\frac{7}{8}$ part of the work

$= \frac{7}{8}\times 4 = \frac{7}{2} = 3\frac{1}{2}$ days

**62.** **(b)** Quicker Method:

$M_1D_1T_1 = M_2D_2T_2$

$\Rightarrow 15\times 20\times 8 = 20\times 12\times T_2$

$\Rightarrow T_2 = \frac{15\times 20\times 8}{20\times 12} = 10$ hours

**63.** **(d)** (Raj + Ram)'s 1 day's work $= \frac{1}{10}$

Raj's 1 day's work $= \frac{1}{12}$

$\therefore$ Ram's 1 day work $= \frac{1}{10} - \frac{1}{12} = \frac{6-5}{60} = \frac{1}{60}$

$\therefore$ Required time = 60 days

**64.** **(c)** Quicker Method:

$M_1D_1 = M_2D_2$

$\Rightarrow\ x\cdot x = y\cdot D_2$

$\Rightarrow\ D_2 = \frac{x^2}{y}$ days

**65.** **(c)** Let the fourth person complete the entire work in ***x*** days.

Now, according to the question:

$\frac{3}{8} + \frac{3}{12} + \frac{3}{16} + \frac{3}{x} = 1$

$\Rightarrow\ \frac{1}{x} = \frac{1}{3} - \frac{1}{8} - \frac{1}{12} - \frac{1}{16} = \frac{16-6-4-3}{48} = \frac{1}{16}$

$\therefore\ x = 16$

Ratio of wages $= \frac{1}{8}:\frac{1}{12}:\frac{1}{16}:\frac{1}{16} = 6:4:3:3$

Sum of ratios = 6 + 4 + 3 + 3

$\therefore$ Fourth person's share $= \frac{3}{16}\times 1200 = ₹225$ .

**66.** **(b)** Let A alone do the work in x days and B alone do the work in y days.

Now according to the question,

$\frac{1}{x} + \frac{1}{y} = \frac{1}{5}$ ...(1)

Again, $\frac{2}{x} + \frac{1}{3y} = \frac{1}{3}$ ...(2)

By equation (2) × 3 – (1), we have

$\frac{6}{x} + \frac{1}{y} - \frac{1}{x} - \frac{1}{y} = 1 - \frac{1}{5}$

$\Rightarrow\ \frac{6}{x} - \frac{1}{x} = \frac{4}{5} \iff \frac{6-1}{x} = \frac{4}{5}$

$\Rightarrow\ x = \frac{25}{4} = 6\frac{1}{4}$ days

**67.** **(c)** Work done by A and B in 7 days

$= \frac{7}{20} + \frac{7}{30} = \frac{21+14}{60} = \frac{35}{60} = \frac{7}{12}$

Remaining work $= 1 - \frac{7}{12} = \frac{5}{12}$

$\therefore$ Time taken by $C = \frac{12}{5}\times 10 = 24$ days

**68.** **(d)** Time taken by Ramesh $= 4\times\frac{2}{3}=\frac{8}{3}$ days

Work done by all the three in 1 day

$= \frac{1}{4}+\frac{1}{6}+\frac{3}{8}=\frac{6+4+9}{24}=\frac{19}{24}$

$\therefore$ Required time $=\frac{24}{19}=1\frac{5}{19}$ days

**69.** **(b)** Quicker Method:

$D_1T_1 = D_2T_2$

$\Rightarrow 18\times6=12\times T_2$

$\Rightarrow T_2=\frac{18\times6}{12}=9$ hours

**70.** **(a)** 1 Man's 1 day's work $=\frac{1}{2x}$

1 Woman's 1 day's work $=\frac{1}{3y}$

$\therefore$ Required ratio $=\frac{1}{2x}:\frac{1}{3y}=3y:2x$

**71.** **(a)** (A + B)'s 1 day's work $=\frac{1}{12}+\frac{1}{15}=\frac{5+4}{60}=\frac{3}{20}$

Work done by A in 6 days $=6\times\frac{1}{12}=\frac{1}{2}$

Remaining work $=1-\frac{1}{2}=\frac{1}{2}$

Time taken by (A + B) in doing half of the work

$=\frac{20}{3}\times\frac{1}{2}=\frac{10}{3}=3\frac{1}{3}$ days

**72.** **(d)** Time taken by A in doing the work = 35 days

Time taken by B in doing the same work = 15 days

B's 3 days' work $=\frac{3}{15}=\frac{1}{5}$

Remaining work $=1-\frac{1}{5}=\frac{4}{5}$

$\therefore$ Time taken by A in finishing the remaining work

$=\left(35\times\frac{4}{5}\right)=28$ days

**73.** **(d)** Times taken by B in completing the work

$=\left(12\times\frac{100}{160}\right)=\frac{15}{2}$ days

$\therefore$ (A + B)'s 1 day's work $=\frac{1}{12}+\frac{2}{15}=\frac{5+8}{60}=\frac{13}{60}$

Hence the work will be completed in $\frac{60}{13}$ days

**74.** **(b)** $(2m + 4b) \times 10 = (4m + 5b) \times 6$

$\Rightarrow 20m + 40b \equiv 24m + 30b$

$\Rightarrow 4m = 10b$

$\Rightarrow 2m = 5b$

$\therefore 5b = 2 \times 40$

$\Rightarrow b=\frac{2\times40}{5}=16$

$\therefore$ Required ratio = 40:16 = 5:2

**75.** **(a)** Work done in first two days

$=\frac{2}{30}+\frac{1}{20}+\frac{1}{10}=\frac{1}{15}+\frac{1}{20}+\frac{1}{10}=\frac{4+3+6}{60}=\frac{13}{60}$

Work done in first 8 days $=\frac{13}{60}\times\frac{8}{2}=\frac{52}{60}$

Remaining work $=1-\frac{52}{60}=\frac{8}{60}=\frac{2}{15}$

Now, it is the turn of A and B,

$\therefore$ (A + B)'s 1 day's work

$=\frac{1}{30}+\frac{1}{20}=\frac{2+3}{60}=\frac{1}{12}$

$\therefore$ Remaining work $=\frac{2}{15}-\frac{1}{12}=\frac{8-5}{60}=\frac{3}{60}=\frac{1}{20}$

Now, it is the turn of A and C,

$\therefore$ (A + C)'s 1 day's work

$=\frac{1}{30}+\frac{1}{10}=\frac{1+3}{30}=\frac{2}{15}$

$\therefore$ Times taken to complete the remaining work

$=\frac{1}{20}\times\frac{15}{2}=\frac{3}{8}$ days

Total time $=\left(8+1+\frac{3}{8}\right)=9\frac{3}{8}$ days

**76.** **(b)** Let, the work be finished in $x$ days.

$\therefore$ work done by A in 6 days + work done by B in $(x - 6)$ days + work done by C in $x$ days = 1

Now, according to the question,

$$\frac{6}{24}+\frac{(x-6)}{32}+\frac{x}{64}=1$$

$$\Rightarrow \frac{x-6}{32}+\frac{x}{64}=1-\frac{1}{4}=\frac{3}{4}$$

$$\Rightarrow \frac{2x-12+x}{64}=\frac{3}{4}$$

$$\Rightarrow 3x-12=\frac{3}{4}\times64=48$$

$$\Rightarrow 3x=60$$

$$\therefore x=\frac{60}{3}=20 \text{ days.}$$

**77.** **(d)** Work done by (P + Q + R) = 1 $\cdots(1)$

Work done by $(P+Q)=\frac{19}{23}$ $\cdots(2)$

Work done by $(Q+R)=\frac{8}{23}$ $\cdots(3)$

From equations (2) + (3) − (1)

$$Q = \frac{19}{23} + \frac{8}{23} - 1 = \frac{27 - 23}{23} = \frac{4}{23}$$

$\therefore$ Wage of $Q = \frac{4}{23} \times 5750 = ₹1000$

**78.** **(b)** A's work done (in one day) $= x = \frac{1}{12}$

$\therefore$ Work done by B in one day $= \left(x + \frac{x \times 60}{100}\right)$

$= x \times \frac{160}{100} = \frac{1}{12} \times \frac{160}{100} = \frac{2}{15}$

$\therefore$ Time required to complete the same work by B

$= \frac{1}{\frac{2}{15}} = 7\frac{1}{2}$ days

**79.** **(d)** Let, one day's work of A, B and C be a, b and c respectively.

Given that, $a + b = \frac{1}{12}$ ...(1)

$b + c = \frac{1}{15}$ ...(2)

And, $a = 2c$ ...(3)

Now, putting the value of a from Eqn. (3) in Eqn. (1), we have,

$2c + b = \frac{1}{12}$ ...(4)

On solving Eqn. (4) and (2), we get

$2c + 2b = \frac{2}{15}$

$2c + b = \frac{1}{12}$

$-\quad -\quad\quad -$

$\therefore b = \frac{2}{15} - \frac{1}{12} = \frac{8-5}{60} = \frac{1}{20}$

$\therefore$ B alone will complete the same work = 20 days.

**80.** **(d)** Let a man complete x part in one day and a woman complete y part in one day.

$\therefore$ According to the question,

$4x + 6y = \frac{1}{8}$ ...(1)

$3x + 7y = \frac{1}{10}$ ...(2)

On solving Eqn. (1) and (2), we have $y = \frac{1}{400}$

$\therefore$ One woman will complete $= y = \frac{1}{400}$ partof work in one day.

$\Rightarrow$ 20 women will complete $= \frac{20}{400} = \frac{1}{20}$ part of work in one day.

$\therefore$ Required time = 20 days.

**81.** **(b)** All three spend equal amount of time on typing. Required ratio of all the three

$A : B : C = \frac{1}{12} : \frac{1}{15} : \frac{1}{24} = 10 : 8 : 5$

So, the number of pages typed by $B = \frac{8 \times 506}{23} = 176$

**82.** **(d)** A and B can finish the work in 20 days.

$\therefore$ A and B's one day's work $= \frac{1}{20}$

B and C can finish the work in 30 days.

$\therefore$B and C's one day's work $= \frac{1}{30}$

A and C can finish the work in 40 days

A and C's one day's work $= \frac{1}{40}$

Adding, we get 2(A + B + C)'s one day's work

$= \frac{1}{20} + \frac{1}{30} + \frac{1}{40} = \frac{6+4+3}{120} = \frac{13}{120}$

$\therefore$ (A + B + C)'s one day's work $= \frac{13}{120 \times 2} = \frac{13}{240}$

A's one day's work

$= \frac{13}{240} - \frac{1}{30}$

$= \frac{13-8}{240} = \frac{5}{240} = \frac{1}{48}$

$\therefore$ A alone can finish the work in 48 days.

C's one day work $= \frac{13}{240} - \frac{1}{20} = \frac{13-12}{240} = \frac{1}{240}$

$\therefore$ C alone can finish the work in 240 days.

Required ratio $= \frac{48}{240} = 1{:}5$

**83.** **(c)** Ratio of the work done by Sujit and Amit = 4:5

Total key depressions done by Amit

$= \frac{5}{9} \times 576000 = 3,20,000$

Amit's speed in key depressions per hour $= \frac{320000}{8 \times 5}$

$= 8000$

**84.** **(c)** $\frac{M_1 D_1 H_1}{W_1} = \frac{M_2 D_2 H_2}{W_2}$

$\Rightarrow \frac{4 \times 10 \times 5}{1} = \frac{2 \times 20 \times H_2}{2}$

$\Rightarrow$ $H_2$ = 10 hours

**85.** **(b)** 2 men = 2 women

$1\text{ man} + 1\text{ woman} = \left(\frac{3}{2} + 1\right)\text{ women} = \frac{5}{2}\text{ women}$

$\because M_1 D_1 = M_2 D_2$

$\Rightarrow \quad 3\times 4=\frac{5}{2}\times D_2$

$\therefore \quad D_2=\frac{3\times 4\times 2}{5}=\frac{24}{5}$ days

**86.** **(c)** Here, there are four quantities, examiner, no. of answer papers, day and hour. We have to calculate hours. Hence the quantity 'hour' should be in the last column. Following relationship exists:

(i) *Less* examiners, *More* hours (inverse)

(ii) *More* answer papers, *more* hours (direct)

(iii) *More* days, *less* hours (inverse)

Hence,

| Examiner | Answer Papers | Days | Hours |
|---|---|---|---|
| 4 ↑ | 1 ↓ | 10 ↑ | ↓ 5 |
| 2 | 2 | 20 | x |

Again,

$$\left.\begin{array}{r}3:4\\1:2\\20:10\end{array}\right\}::5:x$$

or, 2 × 1 × 20 ×$x$ = 4 × 2 × 10 × 5

$\therefore \quad x=\frac{4\times 2\times 10\times 5}{2\times 1\times 20}=$ 10 hours per day

**88.** **(d)** Let A and B together complete the work in $x$ days. Then, time taken by A = ($x$ + 4) days

And, time taken by B = ($x$ + 16) days

Now, according to the question,

$$\frac{1}{x+4}+\frac{1}{x+16}=\frac{1}{x}$$

$$\Rightarrow \quad \frac{x+16+x+4}{(x+4)(x+16)}=\frac{1}{x}$$

$\Rightarrow \quad 2x^2+20x=x^2+20x+64$

$\Rightarrow \quad x^2=64 \quad \Rightarrow \quad x=\sqrt{64}=8$ days

**89.** **(c)** $M_1D_1T_1=M_2D_2T_2$

$\Rightarrow \quad 250\times 20\times 5=M_2\times 10\times 8$

$\Rightarrow \quad M_2=\frac{250\times 20\times 5}{10\times 8}=312.5$

$\therefore$ Minimum number of men required = 313

**90.** **(a)** $(2M+5W)\times 12=(5M+2W)\times 9$

$\Rightarrow \quad 24M+60W=45M+18W$

$\Rightarrow \quad 42W=21M$

$\Rightarrow \quad 2W=1M$

$\therefore 2M+5W=9W$

$\therefore \quad M_1D_1=M_2D_2$

$\Rightarrow \quad 9\times 12=3\times D_2$

$\Rightarrow \quad D_2=\frac{9\times 12}{3}=36$ days

# Pipes and Cisterns

11

## INTRODUCTION

*Pipes* are connected to a *tank* or *cistern* and are used to fill or emptying the tank.

**Inlet:** A pipe connected to a tank or a cistern that fills, it, is known as *inlet*.

**Outlet:** A pipe connected to a tank or a cistern emptying it is known as *outlet*.

Pipes and Cistern-related mathematical problems are similar to those on 'Time and Work'. The only difference noted is, the work done is in terms of filling or emptying a cistern. The time taken is t by a pipe is the time taken by a pipe or a leak (crack) to fill or emptying a cistern.

Generally, the time taken to fill a cistern is considered as positive. On the other hand, the time taken to empty a cistern is considered as negative. The amount of work done, that is, filling or emptying a cistern is, generally, taken as unity, unless otherwise specified.

## SOME BASIC FORMULAE

1. If an inlet can completely fill the empty tank in $X$ hours, the part of the tank filled in 1 hour $= \frac{1}{X}$.
2. If an outlet can empty the full tank in $Y$ hours, the part of the tank emptied in 1 hour $= \frac{1}{Y}$.
3. If both inlet and outlet are open, net part of the tank filled in 1 hour $= \frac{1}{X} - \frac{1}{Y}$.

**Illustration 1:** A pipe can fill a tank in 5 hours. Find the part of tank filled in one hour.

**Solution:** The part of the tank filled in 1 hour $= \frac{1}{5}$.

**Illustration 2:** A pipe can fill a tank in 28 minutes. Find the time in which $\frac{1}{7}$ part of the tank will be filled.

**Solution:** We have, $\frac{1}{28}$ part of the tank is filled in 1 minute.

$\therefore$ $\frac{1}{7}$ part of the tank is filled in $\frac{28}{7}$ minutes

$= 4$ minutes.

**Illustration 3:** A pipe can empty a cistern in 40 minutes. Find the time in which $\frac{3}{4}$ part of the cistern will be emptied.

**Solution:** We have, $\frac{1}{40}$ part of the cistern is emptied in = 1 minute.

$\therefore$ $\frac{3}{4}$ part of the cistern is emptied in

$= 40 \times \frac{3}{4} = 30$ minutes.

**Illustration 4:** A pipe can empty a cistern in 12 hours. Find the part of the cistern emptied in 4 hours.

**Solution:** We have, part of the cistern emptied in 1 hour $= \frac{1}{12}$,

$\therefore$ Part of the cistern emptied in 4 hours $= \frac{1}{12} \times 4 = \frac{1}{3}$.

**Illustration 5:** A tap can fill a cistern is 8 hours and another can empty it in 16 hours. If both the taps are opened simultaneously, find the time (in hours) to fill the cistern.

**Solution:** Here, $X = 8$ and $Y = 16$.

$\therefore$ Part of the cistern filled in 1 hour

$$= \frac{1}{X} - \frac{1}{Y}$$

$$= \frac{1}{8} - \frac{1}{16} = \frac{1}{16}$$

$\therefore$ Total time taken to fill the cistern = 16 hours.

## SOME USEFUL SHORTCUT METHODS

1. Two pipes A, and B, can fill (or empty) a cistern in $X$ and $Y$ hours, while working alone. If both the pipes are opened together, then the time taken to fill (or empty) the cistern is given by

$$\left(\frac{XY}{X+Y}\right)\text{hours.}$$

**Explanation**

Part of the cistern filled (or emptied) by pipe A alone in 1 hour = $\frac{1}{X}$.

Part of the cistern filled (or emptied) by pipe B alone in 1 hour = $\frac{1}{Y}$.

∴ Part filled (or emptied) by (A + B) in 1 hour

$$= \frac{1}{X}+\frac{1}{Y}=\frac{X+Y}{XY}$$

Therefore, both the pipes A and B together will fill (or empty) the cistern in $\left(\frac{XY}{X+Y}\right)$ hours.

**Illustration 6:** Two pipes A and B can fill a cistern in 20 and 30 minutes. If both the pipes are opened simultaneously, how long will it take to fill the cistern?

**Solution:** Here, $X = 20$ and $Y = 30$.

∴ Part of the cistern filled by (A + B) in 1 minute

$$= \frac{1}{X}+\frac{1}{Y}=\frac{1}{20}+\frac{1}{30}=\frac{5}{60}=\frac{1}{12}.$$

∴ Both the pipes A and B together will fill the cistern in 12 minutes.

2. Three pipes A, B and C can fill a cistern in $X$, $Y$ and $Z$ hours respectively, while working alone. If all the three pipes are opened together, the time taken to fill the cistern is given by

$$\left(\frac{X\times Y\times Z}{XY+YZ+ZX}\right)\text{hours.}$$

**Explanation**

Part of the cistern filled by A alone in 1 hour $= \frac{1}{X}$

Part filled by B alone in 1 hour = $\frac{1}{Y}$

Part filled by C alone in 1 hour = $\frac{1}{Z}$

All the three pipes are opened.

∴ Part filled in 1 hour $= \frac{1}{X}+\frac{1}{Y}+\frac{1}{Z}$

$$= \frac{XY+YZ+ZX}{XYZ}$$

∴ The cistern will be filled in $\frac{XYZ}{XY+YZ+ZX}$ hours.

**Note:**

We can generate more formulae like above by replacing negative sign wherever a pipe starts emptying a cistern instead of the standard positive sign.

**Illustration 7:** Two pipes, A and B, can separately fill a cistern is 8 hours and 12 hours respectively, while a third pipe C can empty it in 6 hours. In what time will the cistern be full, if all the pipes are opened together?

**Solution:** Here, $X = 8$, $Y = 12$ and $Z = -6$.

∴ The cistern will be full in

$$= \left(\frac{8\times12\times-6}{8\times12-12\times6-6\times8}\right)\text{hours}$$

$$= \left(\frac{576}{24}\right)\text{hours or 24 hours.}$$

3. Two pipes, A and B, can fill a cistern in $X$ hours and $Y$ hours, respectively. There is also an outlet C. If all the three pipes are opened together, the tank is full in $Z$ hours. The time taken by C to empty the full tank is given by

$$\left(\frac{XYZ}{XZ+YZ-XY}\right)\text{hours.}$$

**Explanation**

Part of the tank emptied by $C$ in 1 hour

$$= \left(\left(\frac{1}{X}+\frac{1}{Y}-\frac{1}{Z}\right)\right)$$

∴ $C$ can empty the full tank in $\left(\frac{XYZ}{XZ+YZ-XY}\right)$ hours.

**Illustration 8:** Two taps A and B can fill a cistern in 30 minutes and 60 minutes, respectively. There is a third exhaust tap C at the bottom of the tank. If all the taps are opened at the same time, the cistern will be full in 45 minutes. In what time can exhaust tap C empty the cistern when it is full?

**Solution:** Here, $X = 30$, $Y = 60$ and $Z = 45$.

$\therefore$ Exhaust tap C can empty the cistern in

$$= \left(\frac{XYZ}{XZ + YZ - XY}\right) \text{ minutes}$$

$$= \left(\frac{30 \times 60 \times 45}{30 \times 45 \times 60 \times 45 - 30 \times 60}\right) \text{minutes} = 36 \text{ minutes.}$$

> 4. A tank takes $X$ hours to be filled by a pipe. But, due to a leak, it is filled in $Y$ hours. The amount of time in which the leak can empty the full tank
>
> $$= \left(\frac{XY}{Y - X}\right) \text{hours.}$$

**Illustration 9:** A pipe can fill a tank in 12 hours. Due to leakage at the bottom, it is filled in 24 hours. If the tank is full, how much time will the leak take to empty it?

**Solution:** Here, $X = 12$ and $Y = 24$.

$\therefore$ The time taken by the leak to empty the full tank

$$= \left(\frac{XY}{Y - X}\right) \text{hours} = \left(\frac{12 \times 24}{24 - 12}\right) \text{hours or 24 hours.}$$

> 5. A cistern has a leak which can empty it in $X$ hours. A pipe which admits $Y$ litres of water per hour into the cistern is turned on and now the cistern is emptied in $Z$ hours. The capacity of the cistern is
>
> $$\left(\frac{XYZ}{Z - X}\right) \text{ litres.}$$

**Illustration 10:** A leak at the bottom of a tank can empty the full tank in 6 hours. An inlet pipe fills water at the rate of 4 litres per minute. When the tank is full, the inlet is opened and due to leak, the tank is empty in 8 hours. Find out the capacity of the tank.

**Solution:** Here, $X = 6$, $Y = 4 \times 60 = 240$ and $Z = 8$.

$\therefore$ The capacity of the tank is

$$= \left(\frac{XYZ}{Z - X}\right) \text{litres} = \left(\frac{6 \times 240 \times 8}{8 - 6}\right) \text{ litres} = 5760 \text{ litres.}$$

> 6. One fill pipe A is $k$ times faster than the other fill pipe B.
>
> (a) If B can fill a cistern in $x$ hours, then the time in which the cistern will be full, if both the fill pipes are opened together, is $\left(\frac{x}{k+1}\right)$ hours.
>
> (b) If A can fill a cistern in $y$ hours, then the time in which the cistern will be full, if both the fill pipes are opened together, is $\left(\frac{k}{k+1}\right)y$ hours.

**Illustration 11:** One fill pipe A is 10 times faster than the second fill pipe B. If B can fill a cistern in 55 minutes, then find the time when the cistern will be full if both fill pipes are opened together.

**Solution:** Here, $k = 10$ and $x = 55$.

$\therefore$ The cistern will be full in

$$= \left(\frac{x}{k+1}\right) \text{ minutes} = \left(\frac{55}{10+1}\right) \text{minutes or 5 minutes.}$$

**Illustration 12:** One fill pipe A is 4 times faster than the second fill pipe B. If A can fill a cistern in 15 minutes, then find out the time when the cistern will be full if both fill pipes are opened together.

**Solution:** Here, $k = 4$ and $y = 15$.

$\therefore$ The cistern will be full in $= \left(\frac{k}{k+1}\right)y$ minutes

$$= \left(\frac{4}{4+1}\right) 15 \text{ minutes} = 12 \text{ minutes.}$$

> 7. If one fill pipe A is $k$ times faster and takes $x$ minutes less time than the other fill pipe B, then
>
> (a) the time taken to fill a cistern, if both the pipes are opened together is $\left(\frac{kx}{(k-1)^2}\right)$ minutes.
>
> (b) A will fill the cistern in $\left(\frac{x}{k-1}\right)$ minutes.
>
> (c) B will fill the cistern in $\left(\frac{kx}{k-1}\right)$ minutes.

**Illustration 13:** One fill pipe A is 5 times faster than the second fill pipe B, and takes 32 minutes less than the fill pipe B. When will the cistern be full if both fill pipes are opened together?

**Solution:** Here, $k = 5$ and $x = 32$.

$\therefore$ The cistern will be full in $= \dfrac{kx}{(k-1)^2}$ minutes

$$= \frac{5 \times 32}{(5-1)^2} \text{ minutes}$$

$$= 10 \text{ minutes.}$$

## Exercise-1

1. One tap can fill a cistern in 2 hours and another can empty the cistern in 3 hours. How long will they take to fill the cistern if both the taps are opened?
   (a) 6 hours (b) 7 hours
   (c) 6.30 hours (d) None of these

2. A tap can fill a tank in 25 minutes and another can empty it in 50 minutes. Find out whether the tank will be filled up or emptied in how many minutes?
   (a) The tank is filled up in 50 minutes.
   (b) The tank is emptied in 25 minutes.
   (c) The tank is filled up in 25 minutes.
   (d) None of these

3. A water tank is $\frac{2}{5}$ full. Pipe A can fill the tank in 10 minutes and pipe B can empty it in 6 minutes. If both the pipes are open, then how long will it take to empty or fill the tank completely?
   (a) 6 minutes to fill (b) 6 minutes to empty
   (c) 8 minutes to fill (d) None of these

4. Two taps A and B can fill a tank in 10 hours and 15 hours, respectively. If both the taps are opened together, the tank will be full in:
   (a) 8 hours (b) 6 hours
   (c) 5 hours (d) None of these

5. Two pipes A and B can separately empty a cistern in 12 hours and 15 hours, respectively. In what time will the cistern be emptied, if both the pipes are opened together?
   (a) 5 hours 30 minutes (b) 7 hours
   (c) 6 hours 40 minutes (d) None of these

6. Two pipes can fill a tank in 10 hours and 12 hours, respectively. While a third pipe emptied the full tank in 20 hours. If all the three pipes operate simultaneously, in how much time the tank will be filled?
   (a) 7 hours 30 minutes (b) 6 hours 40 minutes
   (c) 8 hours 30 minutes (d) None of these

7. Three pipes A, B and C can fill a cistern in 10, 12 and 15 hours, respectively, while working alone. If all the three pipes are opened together, the time taken to fill the cistern will be:
   (a) 4 hours (b) 6 hours
   (c) 7 hours (d) None of these

8. Two pipes A and B can fill a cistern in 24 minutes and 30 minutes, respectively. There is also an outlet C. If all the three pipes are opened together, the cistern is full in 20 minutes. How much time will be taken by outlet C to empty the full cistern?
   (a) 30 minutes (b) 40 minutes
   (c) 45 minutes (d) None of these

9. A cistern is normally filled in 8 hours, but it takes 2 hours longer to fill because of a leak at its bottom. If the cistern is full, the leak will empty it in:
   (a) 35 hours (b) 45 hours
   (c) 40 hours (d) None of these

10. A cistern has a leak which would empty in 8 hours. A tap is turned on which admits 6 litres a minute into the cistern and it is now emptied in 12 hours. The cistern can hold:
   (a) 6840 litres (b) 7860 litres
   (c) 8640 litres (d) None of these

11. If two pipes function simultaneously, the reservoir will be filled in 12 hours. One pipe fills the reservoir 10 hours faster than the other. How many hours does the faster pipe take to fill the reservoir?
   (a) 35 hours (b) 30 hours
   (c) 40 hours (d) None of these

12. One fill pipe A is 3 times faster than second fill pipe B and takes 32 minutes less than the fill pipe B. When will the cistern be full if both the pipes are opened together?
   (a) 28 mintues (b) 24 minutes.
   (c) 30 minutes (d) Data inadequate

13. Two pipes A and B can fill a cistern in 4 minutes and 6 minutes, respectively. If these pipes are turned on alternately for 1 minute each, then how long will it take for the cistern to fill?
   (a) 4 m 40 s (b) 3 m 20 s
   (c) 4 m 50 s (d) 3 m 30 s

14. There are two taps to fill a tank while a third to empty it. When the third tap is closed, they can fill the tank in 10 minutes and 12 minutes, respectively. If all the three taps be opened, the tank is filled in 15 minutes. If the first two taps are closed, in what time can the third tap empty the tank when it is full?
   (a) 7 minutes
   (b) 9 minutes and 32 Seconds
   (c) 8 minutes and 34 Seconds
   (d) 6 minutes

**15.** Two pipes, A and B, can separately fill a cistern in 15 minutes and 18 minutes, respectively, while a third pipe C can empty it in 6 minutes. Two pipes, A and B, are kept open for 6 minutes in the beginning and, then the third pipe is also opened. In what time will the cistern be emptied?

(a) $16\frac{1}{2}$ minutes (b) 15 minutes

(c) $15\frac{1}{2}$ minutes (d) 16 minutes

**16.** A reservoir is fitted with two pipes A and B. Pipe A can fill the reservoir 5 hours faster than pipe B. If both the pipe together fill the reservoir in 6 hours, the reservoir will be filled by A alone in:

(a) 10 hours (b) 8 hours

(c) 12 hours (d) 11 hours

**17.** A cistern is provided by two taps A and B. Tap A can fill it in 20 minutes and tap B in 25 minutes. Both the taps are kept open for 5 minutes and, then the second is turned off. The cistern will be completely filled in another:

(a) 11 minutes (b) 10 minutes

(c) 15 minutes (d) 12 minutes

**18.** Two pipes, A and B, can separately fill a tank in 6 hours and 8 hours, respectively. Both the pipes are opened together, but $1\frac{1}{2}$ hours later pipe A is turned off. How much time will it take to fill the tank?

(a) 5 hours (b) 6 hours

(c) $4\frac{1}{2}$ hours (d) $5\frac{1}{2}$ hours

**19.** A cistern has two taps which fill it in 12 minutes and 15 minutes, respectively. There is also a waste pipe in the cistern. When all the pipes are opened, the empty cistern is full in 20 minutes. How long will the waste pipe take to empty a full cistern?

(a) 8 minutes (b) 10 minutes

(c) 12 minutes (d) 16 minutes

**20.** Two taps can separately fill a cistern in 10 minutes and 15 minutes, respectively. When the waste pipe is open, they can together fill it in 18 minutes. The waste pipe can empty the full cistern in:

(a) 7 minutes (b) 9 minutes

(c) 13 minutes (d) 23 minutes

## EXERCISE-2
## (BASED ON MEMORY)

**1.** A cistern has two pipes. One can fill it with water in 8 hours and the other can empty it in 5 hours. In how many hours will the cistern be emptied if both the pipes are opened together when $\frac{3}{4}$ of the cistern is already full of water?

(a) $13\frac{1}{3}$ hours (b) 10 hours

(c) 6 hours (d) $\frac{1}{3}$ hours

**[SSC (GL) Prel. Examination, 2007]**

**2.** Tap 'A' can fill a water tank in 25 minutes, tap 'B' can fill the same tank in 40 minutes and tap 'C' can empty that tank in 30 minutes. If all the three taps are opened together, in how many minutes will the tank be completely filled up or emptied?

(a) $3\frac{2}{13}$ (b) $15\frac{5}{13}$

(c) $8\frac{2}{13}$ (d) $31\frac{11}{19}$

(e) None of these

**[BSRB Patna PO, 2001]**

**3.** Taps A, B and C are connected to a water tank and the rate of flow of water is 42 litres/h, 56 litres/h and 48 litres/h, respectively. Taps A and B fill the tank while tap C empties the tank. If all the three taps are opened simultaneously, the tank gets completely filled up in 16 hours. What is the capacity of the tank?

(a) 960 litres (b) 2346 litres

(c) 1600 litres (d) 800 litres

**[SBI PO, 2001]**

**4.** 20 buckets of water fill a tank when the capacity of each bucket is 13.5 litres. How many buckets will be required to fill the same tank if the capacity of each bucket is 9 litres?

(a) 30 (b) 32

(c) Data inadequate (d) None of these

**[IBPS Bank PO, 2002]**

**5.** A pipe of diameter $d$ can drain a certain water tank in 40 minutes. The time taken by a pipe of diameter $2d$ for doing the same job is:

(a) 5 minutes (b) 10 minutes

(c) 20 minutes (d) 50 minutes

**[SSC (GL) Prel. Examination, 2000]**

**6.** A tap can empty a tank in one hour. A second tap can empty it in 30 minutes. If both the taps operate simultaneously, how much time is needed to empty the tank?

(a) 20 minutes (b) 30 minutes
(c) 40 minutes (d) 45 minutes

**[SSC (GL) Prel. Examination, 2000]**

**7.** Two taps can fill a tank in 4 hours and 6 hours, respectively. A third tap can empty the tank in 3 hours. If all the three taps are opened how much time will it take to fill the tank?

(a) 3 hours (b) 9 hours
(c) 12 hours (d) 24 hours

**[SSC (GL) Prel. Examination, 2000]**

**8.** A cistern can be filled with water by a pipe in 5 hours and it can be emptied by a second pipe in 4 hours. If both the pipes are opened when the cistern is full, the time in which it will be emptied is:

(a) 9 hours (b) 18 hours
(c) 20 hours (d) $20\frac{1}{2}$ hours

**[SSC (GL) Prel. Examination, 2002]**

**9.** A pump can fill a tank with water in 2 hours. Because of a leak in the tank it was taking $2\frac{1}{3}$ hours to fill the tank. The leak can drain all the water off the tank in:

(a) 8 hours (b) 7 hours
(c) $4\frac{1}{3}$ hours (d) 14 hours

**[SSC (GL) Prel. Examination, 2002]**

**10.** A cistern is normally filled with water in 10 hours but takes 5 hours longer to fill because of a leak in its bottom. If the cistern is full, then the leak will empty the cistern in:

(a) 20 hours (b) 40 hours
(c) 50 hours (d) 30 hours

**[SSC (GL) Prel. Examination, 2002]**

**11.** Two pipes A and B can separately fill a cistern in 60 minutes and 75 minute respectively. There is a third pipe at the bottom of the cistern to empty it. If all the three pipes are simultaneously opened, then the cistern is full in 50 minutes. In how much time can the third pipe alone empty the cistern?

(a) 110 minutes (b) 100 minutes
(c) 120 minutes (d) 90 minutes

**[SSC (GL) Prel. Examination, 2003]**

**12.** A tap can fill a tank in 6 hours. After half the tank is filled, three more similar taps are opened. What is the total time taken to fill the tank completely?

(a) 4 hours
(b) 4 hours 15 minutes
(c) 3 hours 15 minutes
(d) 3 hours 45 minutes

**[SSC (GL) Prel. Examination 2003]**

**13.** A water tank has three taps A, B and C. Tap A, when opened, can fill the water tank alone in 4 hours. Tap B, when opened, can fill the water tank alone in 6 hours, Tap C, when opened, can empty the water tank alone in 3 hours. If tap A, B and C are opened simultaneously, how long will it take to fill the tank completely?

(a) 10 hours (b) 8 hours
(c) 18 hours (d) 12 hours

**[Indian Bank PO Examination 2011]**

**14.** A pipe fills a water tank three times faster than another pipe. If the two pipes together can fill the empty tank in 36 minutes, then how much time will the slower pipe alone would take to fill the tank?

(a) 1 hour 21 minutes (b) 1 hour 48 minutes
(c) 2 hours (d) 2 hours 24 minutes

**[SSC (GL) Examination 2010]**

**15.** Having the same capacity 9 taps fill up a water tank in 20 minutes. How many taps of the same capacity are required to fill up the same water tank in 15 minutes?

(a) 10 (b) 12
(c) 15 (d) 18

**[SSC, 2014]**

**16.** Two pipes A and B can fill a cistern in 3 hours and 5 hours, respectively. Pipe C can empty in 2 hours. If all the three pipes are open, in how many hours the cistern will be full?

(a) 30 hours (b) 10 hours
(c) 15 hours (d) Cannot be filled

**[SSC Assistant Grade III, 2013]**

**17.** Two pipes can fill a cistern separately in 24 minutes and 40 minutes respectively. A waste pipe can drain off 30 litres per minute. If all the three pipes are opened, the cistern fills in one hour. The capacity (in litres of the cistern) is:

(a) 800 (b) 400
(c) 600 (d) 500

**[SSC Assistant Grade III, 2012]**

**18.** A tank can be filled by pipe A in 2 hours and pipe B in 6 hours. At 10 am pipe A was opened. At what time will the tank be filled if pipe B is opened at 11 am?

(a) 12.45 am (b) 5 pm
(c) 11.45 am (d) 12 pm

**[SSC, 2012]**

**19.** A swimming pool has 3 drain pipes. The first two pipes A and B, operating simultaneously, can empty the pool in half the time that C (the 3rd pipe) alone takes to empty it. Pipe A, working alone, takes half the time taken by pipe B. Together they take 6 hours 40 minutes to empty the pool. Time taken by pipe A to empty the pool, in hours, is:

(a) 15 (b) 10
(c) 30 (d) 7

**[SSC, 2012]**

**20.** A cistern has 3 pipes A, B and C. A and B can fill it in 3 and 4 hours respectively, and C can empty it in 1 hour. If the pipes are opened at 3 pm, 4 pm and 5 pm respectively on the same day, the cistern will be empty at:

(a) 7:12 pm (b) 7:15 pm
(c) 7:10 pm (d) 7:28 pm

**[SSC, 2011]**

**21.** Two pipes can fill an empty tank separately in 24 minutes and 40 minutes respectively and a third pipe can empty 30 gallons of water per minute. If all the three pipes are opened, empty tank becomes full in one hour. The capacity of the tank (in gallons) is:

(a) 800 (b) 600
(c) 500 (d) 400

**[SSC, 2010]**

**22.** A pump can fill a tank with water in 2 hours. Because of a leak, it took $2\frac{1}{3}$ hours to fill the tank. The leak can drain all the water of the tank in:

(a) $4\frac{1}{3}$ hours (b) 7 hours
(c) 8 hours (d) 14 hours
(e) None of these

**[IBPS PO/MT, 2013]**

## ANSWER KEYS

### Exercise-1

**1.** (a) **2.** (a) **3.** (b) **4.** (b) **5.** (c) **6.** (a) **7.** (a) **8.** (b) **9.** (c) **10.** (c) **11.** (b) **12.** (b) **13.** (a)
**14.** (c) **15.** (a) **16.** (a) **17.** (a) **18.** (b) **19.** (b) **20.** (b)

### Exercise-2

**1.** (b) **2.** (d) **3.** (d) **4.** (a) **5.** (b) **6.** (a) **7.** (c) **8.** (c) **9.** (d) **10.** (d) **11.** (b) **12.** (d) **13.** (d)
**14.** (d) **15.** (b) **16.** (d) **17.** (c) **18.** (c) **19.** (a) **20.** (a) **21.** (b) **22.** (d)

# EXPLANATORY ANSWERS

## EXERCISE-1

**1.** **(a)** Here, $X = 2$ and $Y = 3$.

$\therefore$ Part of the cistern filled in 1 hour

$= \frac{1}{X} - \frac{1}{Y} = \frac{1}{2} - \frac{1}{3} = \frac{1}{6}$.

$\therefore$ Total time taken to fill the cistern = 6 hours.

**2.** **(a)** Here, $X = 25$ and $Y = 50$.

$\therefore$ Part of the tank filled or emptied in 1 minute

$$= \frac{1}{X} - \frac{1}{Y} = \frac{1}{25} - \frac{1}{50} = \frac{1}{50},$$

which is positive, therefore the tank will be filled.

$\therefore$ Total time taken to fill the tank = 50 minutes.

**3.** **(b)** Here, $X = 10$ and $Y = 6$.

$\therefore$ Part of the tank filled or emptied in 1 minute

$$= \frac{1}{X} - \frac{1}{Y} = \frac{1}{10} - \frac{1}{6} = -\frac{1}{15},$$

which is negative, therefore the tank will be emptied.

Thus, $\frac{2}{5}$ full of the tank will be emptied in

$= 15 \times \frac{2}{5} = 6$ minutes.

**4.** **(b)** Here, $X = 10$ and $Y = 15$.

$\therefore$ The tank will be full in

$= \left(\frac{XY}{X+Y}\right)$ hours

$= \left(\frac{10 \times 15}{10+15}\right)$ hours, or 6 hours.

**5.** **(c)** Here, $X = 12$ and $Y = 15$.

$\therefore$ The cistern will be empty in

$= \left(\frac{XY}{X+Y}\right)$ hours

$= \left(\frac{12 \times 15}{12+15}\right)$ hours

$= \frac{20}{3}$ hours or, 6 hours 40 minutes.

**6.** **(a)** Here, $X = 10$, $Y = 12$ and $Z = -20$.

$\therefore$ The tank will be full in

$= \left(\frac{X \times Y \times -Z}{XY - YZ - ZX}\right)$ hours

$= \left(\frac{10 \times 12 \times -20}{10 \times 12 - 12 \times 20 - 20 \times 10}\right)$ hours

$= \left(\frac{15}{2}\right)$ hours or, 7 hours 30 minutes.

**7.** **(a)** Here, $X = 10$, $Y = 12$ and $Z = 15$.

$\therefore$ Total time taken to fill the cistern

$= \left(\frac{XYZ}{XY + YZ + ZX}\right)$ hours

$= \left(\frac{10 \times 12 \times 15}{10 \times 12 + 12 \times 15 + 10 \times 15}\right)$ hours

= 4 hours.

**8.** **(b)** Here, $X = 24$, $Y = 30$ and $Z = 20$.

$\therefore$ Total time taken by C to empty the full cistern

$= \left(\frac{XYZ}{XZ + YZ - XY}\right)$ minutes

$= \left(\frac{24 \times 30 \times 20}{24 \times 20 + 30 \times 20 - 24 \times 30}\right)$ minutes

= 40 minutes.

**9.** **(c)** Here, $X = 8$ and $Y = 8 + 2 = 10$.

$\therefore$ The leak will empty the cistern in

$= \left(\frac{XY}{Y - X}\right)$ hours

$= \left(\frac{8 \times 10}{10 - 8}\right)$ hours, or, 40 hours.

**10.** **(c)** Here, $X = 8$, $Y = 6 \times 60 = 360$ and $Z = 12$.

$\therefore$ The capacity of the cistern is

$= \left(\frac{XYZ}{Z - X}\right)$ litres $= \left(\frac{8 \times 360 \times 12}{12 - 8}\right)$ litres

= 8640 litres.

**11.** **(b)** Let, one pipe take $x$ hours to fill the reservoir. The, other pipe takes $(x - 10)$ hours.

$\therefore \frac{1}{x} + \frac{1}{x-10} = \frac{1}{12}$

$\Rightarrow x(x - 10) = 12(x + x - 10)$

$\Rightarrow x^2 - 34x + 120 = 0$

or, $(x - 30)(x - 4) = 0$

$\therefore x = 30$ or, $x = 4$.

$\therefore$ The faster pipe takes 30 hours to fill the reservoir.

**12.** **(b)** Here, $k = 3$ and $x = 32$.

$\therefore$ The cistern will be full in $= \frac{kx}{(k-1)^2}$ minutes

$= \frac{3 \times 32}{(3-1)^2}$ minutes

= 24 minutes.

**13. (a)** As the pipes are operating alternately, thus their 2 minutes job is $\frac{1}{4}+\frac{1}{6}=\frac{5}{12}$.

In the next 2 minutes, the pipes can fill another $\frac{5}{12}$ part of cistern. Therefore, in 4 minutes, the two pipes which are operating alternately will fill $\frac{5}{12}+\frac{5}{12} = \frac{10}{12}=\frac{5}{6}$ part.

The part of the cistern left unfilled $= 1 - \frac{5}{6} = \frac{1}{6}$. Pipe A can fill $\frac{1}{4}$ of the cistern in 1 minute. Pipe A can fill $\frac{1}{6}$ of the cistern in $4 \times \frac{1}{6} = \frac{2}{3}$ minutes. Total time taken to fill the cistern $4 + \frac{2}{3} = 4\frac{2}{3}$ minutes, or, 4 minutes 40 seconds.

**14. (c)** Part emptied by the third pipe in 1 minute

$$=\left(\frac{1}{10}+\frac{1}{12}\right)-\frac{1}{15}=\frac{7}{60}.$$

So, the full tank will be emptied by the third pipe in $\left(\frac{60}{7}\right)$ minute = 8 minute 34 seconds.

**15. (a)** Pipe (A + B)'s 6 minutes job $= 6\left(\frac{1}{15}+\frac{1}{18}\right)$

$$=\frac{11}{15}$$

Net work done by the three pipes (A + B + C) in 1 minute

$$=\left(\frac{1}{15}+\frac{1}{18}\right)-\frac{1}{6}=\frac{-4}{90}=\frac{-2}{45}.$$

Net $\frac{2}{45}$ part of the tank is emptied by pipe C in 1 minute.

Net $\frac{11}{15}$ part of the tank is emptied by pipe C in $\frac{45}{2}\times\frac{11}{15}=\frac{33}{2}$ minutes $= 16\frac{1}{2}$ minutes.

**16. (a)** Let, A alone can fill the reservoir in $x$ hours. Then, B can fill the reservoir in $(x + 5)$ hours.

$\therefore \quad \frac{1}{x}+\frac{1}{x+5}=\frac{1}{6}$

$\therefore \quad 6(2x + 5) = x(x + 5)$

or, $x^2 - 7x - 30 = 0$

or, $(x - 10)(x + 3) = 0$

or, $x = 10$ hours.

**17. (a)** Part filled in 1 minute $= \frac{1}{20}+\frac{1}{25}=\frac{9}{100}$.

Part filled in 5 minutes $= \frac{9}{100}\times 5=\frac{9}{20}$.

Unfilled part $= 1 - \frac{9}{20}=\frac{11}{20}$.

This is to be filled by A alone and, hence will be filled in $20 \times \frac{11}{20} = 11$ minutes.

**18. (b)** Pipe (A + B)'s $1\frac{1}{2}$ hours job $= \frac{3}{2}\left(\frac{1}{6}+\frac{1}{8}\right)$.

Part unfilled $= 1-\frac{7}{16}=\frac{9}{16}$.

Pipe B can fill $\frac{1}{8}$ of the tank in = 1 hour.

Pipe B can fill $\frac{9}{16}$ of the tank in $= 8 \times \frac{9}{16}$

$$= \frac{9}{2} \text{ hours.}$$

Total time taken to fill the tank $= \left(\frac{3}{2}+\frac{9}{2}\right)$ hours = 6 hours.

**19. (b)** Work done by the waste pipe in 1 minute

$$=\left(\frac{1}{12}+\frac{1}{15}\right)-\frac{1}{20}$$

$$=\left(\frac{3}{20}-\frac{1}{20}\right)=\frac{1}{10}$$

$\therefore$ The waste pipe can empty the cistern in 10 minutes.

**20. (b)** Work done by the waste pipe in 1 minute

$$=\left(\frac{1}{10}+\frac{1}{15}\right)-\frac{1}{18}$$

$$=\left(\frac{1}{6}-\frac{1}{18}\right)=\frac{1}{9}$$

$\therefore$ The waste pipe can empty the cistern in 9 minutes.

## EXERCISE-2
## (BASED ON MEMORY)

1. **(b)** In one hour, $\frac{1}{5}-\frac{1}{8}=\frac{3}{40}$ of the cistern is emptied.

   $\therefore$ Whole cistern is emptied in $\frac{40}{3}$ hours

   i.e., $\frac{3}{4}$ of the cistern is emptied in $\frac{40}{3}\times\frac{3}{4}=10$ hours.

3. **(d)** Capacity of the tank = $(42 + 56 - 48) \times 16$ = 800 litres.

4. **(a)** Capacity of the tank = $20 \times 13.5$ = 270 litres

   When the capacity of each bucket = 9 litres then the required number of buckets

   $= \frac{40}{3}$ = 30.

5. **(b)** Ratio of volumes = $\frac{\pi d^2 h}{\pi\left(\frac{d}{2}\right)^2 h}=\frac{4}{1}$

   $\therefore$ A pipe of radius $\frac{d}{2}$ can drain a water tank in 40 minutes.

   $\Rightarrow$ A pipe of radius $d$ can drain the same water tank in 10 minutes.

6. **(a)** In one minute $\frac{1}{60}+\frac{1}{30}=\frac{1}{20}$ of the tank will be empty.

7. **(c)** In one hour, $\frac{1}{4}+\frac{1}{6}-\frac{1}{3}=\frac{3+2-4}{12}$

   $= \frac{1}{12}$ of the tank will be filled.

8. **(c)** Required time = $\frac{5\times 4}{5-4}$ = 20 hours.

9. **(d)** Required time = $\frac{2\times\frac{7}{3}}{\frac{7}{3}-2}$ = 14 hours.

10. **(d)** In one hour, $\frac{1}{10}-\frac{1}{15}=\frac{1}{30}$ of the cistern will be empty.

11. **(b)** Let, the third pipe empty the cistern in K minutes,

    i.e., $\frac{1}{60}+\frac{1}{75}-\frac{1}{K}=\frac{1}{50}$

    or, $\frac{1}{60}+\frac{1}{75}-\frac{1}{50}=\frac{1}{K}$ or, K = 100 minutes.

12. **(d)** Half of the tank is filled in $\frac{1}{2}\times 6 = 3$ hours.

    Now, we have four taps and each tap can fill the tank in 6 hours.

    When all the four taps are opened, then they can fill $\frac{1}{2}$ of the tank in $\frac{6}{4}\times\frac{1}{2}=\frac{3}{2}$ hours = 45 minutes.

    $\therefore$ Total time = 3 hours 45 minutes.

13. **(d)** The required time to fill the tank

    $$= \frac{1}{\left(\frac{1}{4}+\frac{1}{6}\right)-\frac{1}{3}} = \frac{1}{\frac{5}{12}-\frac{1}{3}} = \frac{1}{\frac{1}{12}} = 12 \text{ hours}$$

14. **(d)** Let the time taken by the pipe at faster rate to fill the tank be $x$ minutes.

    Therefore, $\frac{1}{x}+\frac{1}{3x} = \frac{1}{36}$

    $\Rightarrow \frac{3+1}{3x} = \frac{1}{36}$

    $\Rightarrow \frac{4}{3x} = \frac{1}{36}$

    $\Rightarrow 3x = 4 \times 36$

    $\Rightarrow 3x = 144$

    $\Rightarrow x = \frac{148}{3}$ = 48 minutes

    Hence, the time taken by slower pipe
    $= 3x = 3 \times 48 = 144$ minutes
    = 2 hours 24 minutes.

15. **(b) Quicker Method:**

    $M_1D_1 = M_2D_2$

    $\Rightarrow 9\times 20 = M_2\times 15$

    $\Rightarrow M_2 = \frac{9\times 20}{15} = 12$ pipes

***Note:***

Same relation as men and days is applicable here also.

16. **(d)** Part of cistern filled by three pipes in an hour

    $=\frac{1}{3}+\frac{1}{5}-\frac{1}{2}=\frac{10+6-15}{30}=\frac{1}{30}$

    Hence, the cistern will be filled in 30 hours.

17. **(c)** Let the waste pipe drains off the tank in x minutes. According to the question,

    $\frac{1}{24}+\frac{1}{40}-\frac{1}{x}=\frac{1}{60}$

    $\Rightarrow \frac{1}{x}=\frac{1}{24}+\frac{1}{40}-\frac{1}{60}=\frac{5+3-2}{120}=\frac{1}{20}$

    $\Rightarrow x = 20$ minutes

    $\therefore$ Capacity of the cistern = $20 \times 30$ = 600 litres.

**18.** **(c)** Part of the tank filled in 1 hour by pipe $A = \frac{1}{2}$

Part of the tank filled by both pipes in 1 hour $= \frac{1}{2} + \frac{1}{6} = \frac{3+1}{6} = \frac{2}{3}$

$\therefore$ Time taken to fill $\frac{2}{3}$ parts = 60 minutes

$\therefore$ Time taken to fill $\frac{1}{2}$ part $= \frac{60 \times 3}{2} \times \frac{1}{2}$

= 45 minutes

$\therefore$ The tank will be filled at 11:45 am

**19.** **(a)** Times taken by pipe B = $2x$ hours

Times taken by pipe A = $x$ hours

$\therefore$ Time taken by pipe $C = \frac{2}{\frac{1}{2x} + \frac{1}{x}} = \frac{2}{\frac{1+2}{2x}}$

$= \frac{4x}{3}$ hours

Now, according to the question,

$$\frac{1}{x} + \frac{1}{2x} + \frac{3}{4x} = \frac{1}{6 + \frac{40}{60}} = \frac{1}{6 + \frac{2}{3}}$$

$$\Rightarrow \frac{4+2+3}{4x} = \frac{3}{20}$$

$$\Rightarrow 9 \times 20 = 4x \times 3$$

$$\Rightarrow x = \left(\frac{9 \times 20}{4 \times 3}\right) = 15 \text{ hours.}$$

**20.** **(a)** Part of the cistern filled in 2 hours by pipe $A = \frac{2}{3}$

Part of the cistern filled in 1 hours by pipe $B = \frac{1}{4}$

$\therefore$ Total part filled $= \frac{2}{3} + \frac{1}{4} = \frac{8+3}{12} = \frac{11}{12}$

When all three pipes are opened, the part filled in one hour $= \frac{1}{3} + \frac{1}{4} - 1 = \frac{4+3-12}{12} = \frac{-5}{12}$

i.e., $\frac{5}{12}$ part will be emptied per hour.

$\therefore$ Time taken to empty $\frac{11}{12}$ part

$= \frac{11}{12} \times \frac{12}{5} = \frac{11}{5}$ hours

= 2 hours 12 minutes

$\therefore$ Required time = 5 + 2:12 = 7:12 pm.

**21.** **(b)** The first pipe will fill $\frac{1}{24}$ part in 1 minute.

Second pipe will fill $\frac{1}{40}$ part in 1 minute.

Both pipes fill the tank in one minute

$$= \frac{1}{24} + \frac{1}{40} = \frac{5+3}{120} = \frac{1}{15} \text{ part}$$

Another third pipe will empty $\frac{1}{x}$ part in one minute.

$\left(\frac{1}{x} = 30 \text{ gallons}\right)$

Required time to fill the tank $= \frac{1}{\left(\frac{1}{15} - \frac{1}{x}\right)}$ minutes.

Now, according to the question,

$$\frac{15x}{(x-15)} \text{ minutes} = 60 \text{ minutes}$$

$$\Rightarrow \frac{15x}{x-15} = 60 \Rightarrow x = 4x - 60$$

$\Rightarrow$ $x$ = 20 minutes

$\because \frac{1}{x} = 30$ gallons

$\Rightarrow \frac{1}{20}$ part = 30 gallons

$\therefore$ Total capacity = 600 gallons

**22.** **(d)** Part of the tank emptied in 1 hour by the leak $= \frac{1}{2} - \frac{3}{7} = \frac{1}{14}$

$\therefore$ The leak will empty the tank in 14 hours.

# Time and Distance

# 12

## INTRODUCTION

The terms 'Times' and 'Distance' are related to the speed of moving objects.

**Speed:** We define the speed of an object as the distance covered by it in a unit time interval. It is obtained by dividing the distance covered by the object, by the time it has taken to cover that distance.

Thus, $\text{Speed} = \dfrac{\text{Distance travelled}}{\text{Time taken}}$.

***Notes:***

1. If the time taken is constant, the distance travelled is proportional to the speed, that is, more the speed; more the distance travelled at the same time.
2. If the speed is constant, the distance travelled is proportional to the time taken, that is, more the distance travelled; more the time taken at the same speed.
3. If the distance travelled is constant, the speed is inversely proportional to the time taken, that is, more the speed; less the time taken for the same distance travelled.

## SOME BASIC FORMULAE

1. $\text{Speed} = \dfrac{\text{Distance}}{\text{Time}}$
2. Distance = Speed × Time
3. $\text{Time} = \dfrac{\text{Distance}}{\text{Speed}}$

### Units of Measurement

Generally, if the distance is measured in kilometre, we measure time in hours and speed in kilometre per hour and is written as Km/h and if the distance is measured in metre, then time is taken in second and speed in metre per second and is written as m/s.

### Conversion of Units

$$1 \text{ kilometre/hour} = \frac{1000 \text{ metre}}{60 \times 60 \text{ seconds}} = \frac{5}{18} \text{ m/s.}$$

$$\therefore \quad \text{One metre/second} = \frac{18}{5} \text{ Km/h.}$$

Thus, $x \text{ Km/h} = \left(x \times \dfrac{5}{18}\right) \text{ m/s.}$

and, $x \text{ m/s.} = \left(x \times \dfrac{18}{5}\right) \text{ Km/h}$

**Illustration 1:** Calculate the speed of a train which covers a distance of 150 Km in 3 hours.

**Solution:** $\text{Speed} = \dfrac{\text{Distance covered}}{\text{Time taken}} = \dfrac{150}{3} = 50 \text{ Km/h.}$

**Illustration 2:** How long does a 100 metres long train running at the rate of 40 Km/h take to cross a telegraphic pole?

**Solution:** In crossing the pole, the train must travel its own length.

∴ Distance travelled is 100 metres.

$$\text{Speed} = 40 \text{ Km/h.} = \frac{40 \times 1000}{60 \times 60} = \frac{100}{9} \text{ m/s.}$$

$$\therefore \quad \text{Time taken to cross the pole} = \frac{100}{100/9}$$

$$= 9 \text{ seconds.}$$

**Illustration 3:** A train running at a speed of 90 Km/h passes a pole on the platform in 20 seconds. Find the length of the train in metres.

**Solution:** Speed of the train = 90 Km/h

$$= 90 \times \frac{5}{18} = 15 \text{ m/s.}$$

$\therefore$ Length of the train = Speed of the train $\times$ time taken in crossing the pole

$$= 25 \times 20 = 500 \text{ metre.}$$

## SOME USEFUL SHORT CUT METHODS

1. (a) If A covers a distance $d_1$ Km at $s_1$ Km/h and, then $d_2$ Km at $s_2$ Km/h, then the average speed during the whole journey is given by

$$\text{Average speed} = \frac{s_1 s_2 (d_1 + d_2)}{s_1 d_2 + s_2 d_1} \text{ Km/h.}$$

(b) If A goes from $X$ to $Y$ at $s_1$ Km/h and comes back from $Y$ to $X$ at $s_2$ Km/h, then the average speed during the whole journey is given by

$$\text{Average speed} = \frac{2 s_1 s_2}{s_1 + s_2}$$

**Explanation**

(a) Time taken to travel $d_1$ Km at $s_1$ Km/h is

$$t_1 = \frac{d_1}{s_1} \text{ hours.}$$

Time taken to travel $d_2$ Km at $s_2$ Km/h is

$$t_2 = \frac{d_2}{s_2} \text{ hours.}$$

$$\text{Total time taken} = t_1 + t_2 = \left(\frac{d_1}{s_1} + \frac{d_2}{s_2}\right) \text{ hours.}$$

$$= \left(\frac{s_1 d_2 + s_2 d_1}{s_1 s_2}\right) \text{ hours.}$$

Total distance covered = $(d_1 + d_2)$ Km. Therefore,

$$\text{Average speed} = \frac{\text{Total distance covered}}{\text{Total time taken}}$$

$$= \frac{s_1 s_2 (d_1 + d_2)}{(s_1 d_2 + s_2 d_1)} \text{ Km/h.} \quad \cdots(1)$$

(b) Let, the distance from $X$ to $Y$ be $d$ Km.

Take $d_1 = d_2 = d$ Eqution in (1), we get

$$\text{Average speed} = \frac{2 d s_1 s_2}{d(s_1 + s_2)} = \frac{2 s_1 s_2}{s_1 + s_2}$$

**Illustration 4:** A ship sails to a certain city at the speed of 15 knots/h, and sails back to the same point at the rate of 30 knots/h. What is the average speed for the whole journey?

**Solution:** Here, $s_1 = 15$ and $s_2 = 30$.

$$\therefore \quad \text{Average speed} = \frac{2 s_1 s_2}{s_1 + s_2} = \frac{2 \times 15 \times 30}{15 + 30} = 20 \text{ knots/h.}$$

2. A person goes certain distance (A to B) at a speed of $s_1$ Km/h. and returns back (B to A) at a speed of $s_2$ Km/h. If he takes $T$ hours in all, the distance between A and B is

$$T\left(\frac{s_1 s_2}{s_1 + s_2}\right).$$

**Explanation**

Let, the distance between A and B be $d$ Km.

$$\text{Time taken during onward journey} = t_1 = \frac{d}{s_1} \text{ hours.}$$

$$\text{Time taken during return journey} = t_2 = \frac{d}{s_2} \text{ hours.}$$

$\therefore$ Total time taken during the entire journey is

$$T = t_1 + t_2 = \frac{d}{s_1} + \frac{d}{s_2} = \frac{d(s_1 + s_2)}{s_1 s_2}$$

$$\therefore \quad d = T\left(\frac{s_1 s_2}{s_1 + s_2}\right).$$

Thus, the distance between A and B is

$$= T\left(\frac{s_1 s_2}{s_1 + s_2}\right)$$

$$= \text{Total time taken} \times \frac{\text{Product of two speeds}}{\text{Sum of two speeds}}.$$

**Illustration 5:** A boy goes to school at the speed of 3 Km/h and returns with a speed of 2 Km/h. If he takes 5 hours in all, find out the distance in Km between the village and the school.

**Solution:** Here, $s_1 = 3$, $s_2 = 2$ and $T = 5$.

$\therefore$ The distance between the village and the school

$$= T\left(\frac{s_1 s_2}{s_1 + s_2}\right) = 5\left(\frac{3 \times 2}{3 + 2}\right) = 6 \text{ Km.}$$

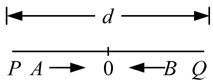
3. If two persons, A and B, start at the same time from two points $P$ and $Q$ towards each other, and after crossing they take $T_1$ and $T_2$ hours in reaching $Q$ and $P$ respectively, then

$$\frac{\text{A's speed}}{\text{B's speed}} = \frac{\sqrt{T_2}}{\sqrt{T_1}}.$$

**Explanation**

Let, the total distance between $P$ and $Q$ be $d$ Km.

Let, the speed of A be $s_1$ Km/h and that of B be $s_2$ Km/h.




Since they are moving in opposite directions, their relative speed is $(s_1 + s_2)$ Km/h.

They will meet after $\left(\dfrac{d}{s_1+s_2}\right)$ hours.

Distance travelled by A in $\left(\dfrac{d}{s_1+s_2}\right)$ hours.

$$= PO = \left(\frac{ds_1}{s_1+s_2}\right) \text{ Km.}$$

Distance travelled by B in $\left(\dfrac{d}{s_1+s_2}\right)$ hours.

$$= QO = \left(\frac{ds_2}{s_1+s_2}\right) \text{ Km.}$$

Time taken by A to travel $QO$

$$= \frac{\left(\dfrac{ds_2}{s_1+s_2}\right)}{s_1}$$

$$= T_1 \text{ (given).} \qquad \cdots(1)$$

Time taken by B to travel $PO$

$$= \frac{\left(\dfrac{ds_1}{s_1+s_2}\right)}{s_2}$$

$$= T_2 \text{ (given)} \qquad \cdots(2)$$

Dividing Equation (2) by Equation (1), we get

$$\frac{s_1/s_2}{s_2/s_1} = \frac{T_2}{T_1}$$

or, $$\left(\frac{s_1}{s_2}\right)^2 = \frac{T_2}{T_1}$$

or, $$\frac{s_1}{s_2} = \sqrt{\frac{T_2}{T_1}}.$$

$$\therefore \quad \frac{\text{A's speed}}{\text{B's speed}} = \sqrt{\frac{T_2}{T_1}}.$$

**Illustration 6:** Nikita starts her journey from Delhi to Bhopal and simultaneously Nishita starts from Bhopal to Delhi. After crossing each other, they finish their remaining journey in $5\frac{4}{9}$ hours and 9 hours, respectively. What is Nishita's speed if Nikita's speed is 36 Km/h?

**Solution:** $$\frac{\text{Nikita's speed}}{\text{Nishita's speed}} = \sqrt{\frac{T_2}{T_1}} = \frac{\sqrt{9}}{\sqrt{5\frac{4}{9}}} = \frac{\sqrt{9}}{\sqrt{\frac{49}{9}}}$$

$$= \sqrt{\frac{81}{49}} = \frac{9}{7}.$$

$$\therefore \quad \text{Nishita's speed} = \frac{7}{9} \text{ Nikita's speed}$$

$$= \frac{7}{9} \times 36 = 28 \text{ Km/h.}$$

4. If a body travels $d_1, d_2, d_3, \ldots, d_n$ metres with different speeds $s_1, s_2, s_3, \ldots, s_n$ m/s in time $T_1, T_2, T_3, \ldots, T_n$ seconds respectively, then the average speed of the body throughout the journey is given by

$$V_a = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

$$= \frac{d_1 + d_2 + d_3 + \cdots + d_n}{T_1 + T_2 + T_3 + \cdots + T_n}$$

[If $d_1, d_2, \ldots, d_n$ and $T_1, T_2, \ldots, T_n$ are known]

and, $$V_a = \frac{s_1T_1 + s_2T_2 + s_3T_3 + \cdots + s_nT_n}{T_1 + T_2 + T_3 + \cdots T_n}$$

[If $d_1, d_2, \ldots, d_n$ and $s_1, s_2, \ldots, s_n$ are known]

**Illustration 7:** A car, during its journey, travels 40 minutes at a speed of 30 Km/h, another 50 minutes at a speed of 60 Km/h and 1 hour at a speed of 30 Km/h. Find out the average speed of the car.

**Solution:** Here, $T_1 = \frac{40}{60}$, $T_2 = \frac{50}{60}$, $T_3 = 1$, $s_1 = 30$, $s_2 = 60$, $s_3 = 30$.

$\therefore$ Average speed of the car

$$= \frac{s_1T_1 + s_2T_2 + s_3T_3}{T_1 + T_2 + T_3} = \frac{30 \times \frac{40}{60} + 60 \times \frac{50}{60} + 30 \times 1}{\frac{40}{60} + \frac{50}{60} + 1}$$

$$= 40 \text{ Km/h}$$

5. If the new speed is $\frac{a}{b}$ of the original speed, then the change in time taken to cover the same distance is given by:

Change in time = $\left(\frac{b}{a}-1\right)$ × original time.

**Illustration 8:** By walking at $\frac{4}{5}$ of his usual speed, Mohan is 6 minutes late to his office. Find out his usual time to cover the distance.

**Solution:** Here, change in time = 6 and $\frac{a}{b} = \frac{4}{5}$.

We have, change in time = $\left(\frac{b}{a}-1\right)$ × original time

$$\Rightarrow \quad \text{original time} = \frac{\text{change in time}}{\left(\frac{b}{a}-1\right)}$$

$$= \frac{6}{\left(\frac{5}{4}-1\right)} = 24 \text{ minutes.}$$

6. A body covers a distance $d$ in time $T_1$ with speed $s_1$, but when it travels with speed $s_2$ covers the same distance in time $T_2$.

The following relations hold

$$\frac{\text{Product of speed}}{d} = \frac{s_1}{T_2} = \frac{s_2}{T_1}$$

$$= \frac{\text{Difference of speed}}{\text{Difference of time}}$$

Equating any two of the above, we can find the unknowns as per the given question.

**Illustration 9:** Two bicyclists do the same journey by travelling 9 Km and 10 Km/h. Find out the length of the journey when one takes 32 minutes longer than the other.

**Solution:** Here, change in speed = 10 – 9 = 1; product of speed = 9 × 10 = 90 and difference of time = $\frac{32}{60}$.

$$\text{We have, } \frac{\text{Product of speed}}{d} = \frac{\text{Difference of speed}}{\text{Difference of time}}$$

$$\Rightarrow \quad d = \text{Product of speed} \times \left(\frac{\text{Difference of time}}{\text{Difference of speed}}\right)$$

$$= 90 \times \frac{32}{60} = 48 \text{ Km.}$$

7. A train travels a certain distance at a speed of $s_1$ Km/h without stoppages and with stoppages. It covers the same distance at a speed of $s_2$ Km/h. The stoppage time per hour is given by

$$\left(\frac{s_1 - s_2}{s_1}\right) \text{hour or, } \left(\frac{\text{Difference of speed}}{\text{Speed without stoppages}}\right)$$

**Explanation**

Let, the distance travelled be $d$ Km.

∴ Time taken by the train without stopping anywhere

$$= \frac{d}{s_1} \text{ hour}$$

Also, time taken by the train with stoppages

$$= \frac{d}{s_2} \text{ hour}$$

$$\text{Total stoppage time} = \frac{d}{s_2} - \frac{d}{s_1} = \left(\frac{s_1 - s_2}{s_1 s_2}\right) d \text{ hour}$$

$$\therefore \quad \text{Stoppage time per hour} = \frac{\left(\frac{s_1 - s_2}{s_1 s_2}\right)d}{\frac{d}{s_2}}$$

$$= \left(\frac{s_1 - s_2}{s_1}\right) \text{ hour}$$

**Illustration 10:** Without stoppages, a train travels certain distance with an average speed of 80 Km/h and with stoppages, it covers the same distance with an average speed of 60 Km/h. How many minutes per hour the train stops?

**Solution:** Here, $s_1$ = 80 and $s_2$ = 60

∴ Stoppage time/h.

$$= \frac{s_1 - s_2}{s_1} = \frac{80-60}{80} = \frac{1}{4} \text{ hour} = 15 \text{ minutes.}$$

8. (a) If a train overtakes a pole or a man or a milestone, then the distance covered in overtaking is equal to the length of the train.

(b) If a train overtakes a bridge or a tunnel or a platform or another train, then the distance covered is equal to the sum of the two lengths.

**Illustration 11:** A train 600 m long crosses a pole in 9 seconds. What is the speed of the train in Km/h?

**Solution:** Speed of the train

$$= \frac{\text{Length of the train}}{\text{time taken in crossing the pole}}$$

$$= \frac{600}{9} \text{ m/s} = \frac{600}{9} \times \frac{18}{5} = 240 \text{ Km/h.}$$

**Illustration 12:** A train 130 m long passes a bridge in 21 seconds moving at a speed of 90 Km/h. Find out the length of the bridge.

**Solution:** We have, speed of the train

$$= \frac{\text{length of the train + length of the bridge}}{\text{time taken in crossing the bridge}}$$

$$\Rightarrow \quad \frac{5}{18} \times 90 = \frac{130 + \text{length of the bridge}}{21}$$

$\therefore$ Length of the bridge = 525 − 130 = 395 m.

9. **Relative Speed**

(a) If two trains of lengths $L_1$ Km and $L_2$ Km, respectively are travelling in the same direction at $s_1$ Km/h and $s_2$ Km/h respectively, such that $s_1 > s_2$, then $s_1 - s_2$ is called their relative speed and the time taken by the faster train to cross the slower train is given by

$$\left(\frac{L_1 + L_2}{s_1 - s_2}\right) \text{ hour.}$$

(b) If two trains of length $L_1$ Km and $L_2$ Km, respectively, are travelling in the opposite directions at $s_1$ Km/h and $s_2$ Km/h, then $s_1 + s_2$ is called their relative speed and the time taken by the trains to cross each other is given by

$$\left(\frac{L_1 + L_2}{s_1 + s_2}\right) \text{ hour.}$$

**Illustrations 13:** A train 135 metres long is running with a speed of 49 Km/h. In what time will it pass a man who is walking at 5 Km/h in the direction opposite to that of the train?

**Solution:** Here, $L_1 = 135$, $L_2 = 0$, $s_1 = 49$ Km/h, $s_2 = 5$ Km/h.

$$\therefore \quad s_1 + s_2 = 49 + 5 = 54 \text{ Km/h.} = 54 \times \frac{5}{18} \text{ m/s.}$$

$$\therefore \quad \text{The time taken} = \frac{L_1 + L_2}{s_1 + s_2} 3 = \frac{135}{54 \times \frac{5}{18}}$$

$$= \frac{135 \times 18}{54 \times 5} = 9 \text{ seconds.}$$

**Illustration 14:** Two trains of length 110 metres and 90 metres are running on parallel lines in the same direction with a speed of 35 Km/h and 40 Km/h, respectively. In what time will they pass each other.

**Solution:** Here, $L_1 = 110$ m, $L_2 = 90$ m, $s_1 = 35$ Km/h and $s_2 = 40$ Km/h

$$\therefore \quad s_2 - s_1 = 40 - 35 = 5 \text{ Km/h} = 5 \times \frac{5}{18} \text{ m/s}$$

$$\therefore \quad \text{Time taken} = \frac{L_1 + L_2}{s_2 - s_1}$$

$$= \frac{110 + 90}{5 \times \frac{5}{18}} = \frac{200 \times 18}{5 \times 5} = 144 \text{ seconds.}$$

**10.** Two trains of lengths $L_1$ m and $L_2$ m run on parallel tracks. When running in the same direction, the faster train passes the slower one in $T_1$ seconds, but when they are running in opposite directions with the same speeds as earlier, they pass each other in $T_2$ seconds.

Then, the speed of the faster train

$$= \frac{L_1 + L_2}{2}\left(\frac{1}{T_1} + \frac{1}{T_2}\right) \text{ m/s}$$

and, the speed of the slower train

$$= \frac{L_1 + L_2}{2}\left(\frac{1}{T_1} - \frac{1}{T_2}\right) \text{ m/s.}$$

**Explanation**

Let the speed of the faster train be $s_1$ m/s and that of the slower train be $s_2$ m/s.

Total distance covered when the two trains cross each other = $L_1 + L_2$.

When the two trains are running is the same direction, their relative speed = $(s_1 - s_2)$ m/s.

$$\therefore \quad (s_1 - s_2) = \frac{L_1 + L_2}{T_1} \quad \cdots(1)$$

When the two trains are running in the opposite directions, their relative speed = $(s_1 + s_2)$ m/s.

$$\therefore \quad s_1 + s_2 = \frac{L_1 + L_2}{T_2} \quad \cdots(2)$$

Adding Equation (1) and (2), we get

$$2s_1 = \frac{L_1 + L_2}{T_1} + \frac{L_1 + L_2}{T_2} = (L_1 + L_2)\left(\frac{1}{T_1} + \frac{1}{T_2}\right)$$

$$\text{or,} \quad s_1 = \left(\frac{L_1 + L_2}{2}\right)\left(\frac{T_1 + T_2}{T_1 T_2}\right).$$

On subtracting Equation (1) from Equation (2), we get

$$2s_2 = (L_1 + L_2)\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

or, $$s_2 = \left(\frac{L_1 + L_2}{2}\right)\left(\frac{T_1 - T_2}{T_1T_2}\right) \text{ m/s.}$$

Therefore,

speed of the faster train

$$= \left(\frac{L_1 + L_2}{2}\right)\left(\frac{T_1 + T_2}{T_1T_2}\right) \text{ m/s.}$$

speed of the slower train

$$= \left(\frac{L_1 + L_2}{2}\right)\left(\frac{T_1 - T_2}{T_1T_2}\right) \text{ m/s.}$$

**Note:**

If the two trains are of equal length, that is, $L_1 = L_2 = L$ (say), then

$$s_1 = L\left(\frac{T_1 + T_2}{T_1T_2}\right) \text{ m/s and, } s_2 = L\left(\frac{T_1 - T_2}{T_1T_2}\right) \text{ m/s.}$$

**Illustration 15:** Two trains of lengths 200 metres and 175 metres run on parallel tracks. When running in the same direction the faster train crosses the slower one in $37\frac{1}{2}$ seconds. When running in opposite directions at speeds same as their earlier speeds, they pass each other completely in $7\frac{1}{2}$ seconds. Find out the speed of each train.

**Solution:** We have, $L_1 = 200$, $L_2 = 175$, $T_1 = \frac{75}{2}$ and $T_2 = \frac{15}{2}$.

Therefore, speed of the faster train

$$= \left(\frac{L_1 + L_2}{2}\right)\left(\frac{T_1 + T_2}{T_1T_2}\right) = \left(\frac{200+175}{2}\right)\left(\frac{\frac{75}{2}+\frac{15}{2}}{\frac{75}{2}\times\frac{15}{2}}\right)$$

$$= \frac{375}{2} \times \frac{45\times4}{75\times15} = 30 \text{ m/s.}$$

Speed of slower train

$$= \left(\frac{L_1 + L_2}{2}\right)\left(\frac{T_1 - T_2}{T_1T_2}\right) = \left(\frac{200+175}{2}\right)\left(\frac{\frac{75}{2}-\frac{15}{2}}{\frac{75}{2}\times\frac{15}{2}}\right)$$

$$= \frac{375}{2} \times \frac{30\times4}{75\times15} = 20 \text{ m/s.}$$

**11.** (a) A train starts from a place at $s_1$ Km/h and another fast train starts from the same place after $T$ hours at $s_2$ Km/h in the same direction. Then, the distance from the starting place at which both the trains will meet is given by

$$\left(\frac{s_1 \times s_2 \times T}{s_2 - s_1}\right) \text{ Km.}$$

Also, the time after which the two trains will meet is given by

$$\left(\frac{s_1T}{s_2 - s_1}\right) \text{ hours.}$$

(b) The distance between two stations A and B is $d$ Km. A train starts from A to B at $s_1$ Km/h. $T$ hours later another train starts from B to A at $s_2$ Km/h. Then, the distance from A, at which both the trains will meet is given by

$$s_1\left(\frac{d + s_2T}{s_1 + s_2}\right) \text{ Km.}$$

Also, the time after which the two trains will meet is given by

$$\left(\frac{d + s_2T}{s_1 + s_2}\right) \text{ hours.}$$

**Illustration 16:** A train starts from Mumbai at 10 am with a speed of 25 Km/h and another train starts from there on the same day at 3 pm in the same direction with a speed of 35 Km/h. Find out at what distance from Mumbai both the trains will meet and also the time of their meeting.

**Solution:** Time from 10 am to 3 pm = 5 hours.

Distance of meeting point from Mumbai

$$= \left(\frac{s_1 \times s_2 \times T}{s_2 - s_1}\right) \text{ Km.}$$

$$= \left(\frac{25\times35\times5}{35-25}\right) \text{ Km} = 437\frac{1}{2} \text{ Km.}$$

Also, time of their meeting

$$= \left(\frac{s_1T}{s_2 - s_1}\right) \text{ hours} = \left(\frac{25\times5}{35-25}\right) \text{ hours}$$

$$= \frac{125}{10} = 12\frac{1}{2} \text{ hours after 3 pm}$$

That is, 3:30 am next day.

**Illustration 17:** Chennai is at a distance of 560 Km from Mumbai. A train starts from Mumbai to Chennai at 6 am with a speed of 40 Km/h. Another train starts from Chennai to Mumbai at 7 am with a speed of 60 Km/h. At what distance from Mumbai and at what time will the two trains be at the point of crossing?

**Solution:** Time from 6 am to 7 am = 1 hour.

Therefore, distance of meeting point from Mumbai

$$= s_1\left(\frac{d+s_2T}{s_1+s_2}\right) \text{ Km.}$$

$$= 40\left(\frac{560+60\times 1}{40+60}\right) = 248 \text{ Km.}$$

Also, time of their meeting

$$= \left(\frac{d+s_2T}{s_1+s_2}\right) \text{ hours}$$

$$= \left(\frac{560+60\times 1}{40+60}\right) = \frac{31}{5} \text{ hours}$$

= 6 hours 12 minutes. after 6 am

That is, at 12.12 noon.

**12.** Two trains start simultaneously from stations A and B towards each other with speeds $s_1$ Km/h and $s_2$ Km/h, respectively. When they meet it is found that the second train had travelled $d$ Km more than the first. Then the distance between the two stations is given by

$$d\left(\frac{s_1+s_2}{s_2-s_1}\right) \text{ Km.}$$

**Explanation**

Let, the distance between the two stations be $x$ Km. If the first train travels $y$ Km, then the second travels $y + d$ Km.

$\therefore \quad x = y + y + d = 2y + d.$

Since the time taken by both the trains is same

$$\therefore \quad \frac{y+d}{s_2} = \frac{y}{s_1}$$

$$\Rightarrow \quad s_1 y + s_1 d = s_2 y$$

$$\Rightarrow \quad (s_2 - s_1)y = s_1 d \text{ or, } y = \frac{s_1 d}{s_2 - s_1}.$$

$$\therefore \quad x = 2\left(\frac{s_1 d}{s_2 - s_1}\right) + d = \frac{d(s_1+s_2)}{(s_2-s_1)} \text{ Km.}$$

**Illustration 18:** Two trains start at the same time from Delhi and Rohtak and proceed towards each other at the rate of 75 Km and 65 Km per hour, respectively. When they meet, it is found that one train has travelled 10 Km more than the other. Find out the distance between Delhi and Rohtak.

**Solution:** Distance between Delhi and Rohtak

$$= d\left(\frac{s_1+s_2}{s_1-s_2}\right) \text{ Km.}$$

$$= 10\left(\frac{75+65}{75-65}\right) \text{ Km}$$

$$= 140 \text{ Km}$$

## EXERCISE-1

1. Ramesh crosses a 600 m long street in 5 minutes. His speed in Km/h is:
   (a) 8.2 (b) 7.2
   (c) 9.2 (d) None of these

2. Compare the speed of two trains, one moving at the speed of 80 Km/h and the other at 10 m/s.
   (a) 30:9 (b) 40:9
   (c) 20:9 (d) None of these

3. Mohan covers 10.2 Km in 3 hours, the distance covered by him in 5 hours is:
   (a) 15 Km (b) 17 Km
   (c) 19 Km (d) None of these

4. A 100 metres long train passes a bridge at the rate of 72 Km/h in 25 seconds. What is the length of the bridge?
   (a) 400 m (b) 17 m
   (c) 600 m (d) None of these

**5.** A train passes a 150 m long railway bridge in 18 seconds. If the train is running at a speed of 60 Km/h., then the length of the train in metres is:

(a) 160 m (b) 150 m
(c) 180 m (d) None of these

**6.** Sound travels 330 metres a second. If the sound of a thunder cloud follows the flash after 10 seconds, the thunder cloud is at a distance of:

(a) 3.7 Km (b) 3.5 Km
(c) 3.3 Km (d) None of these

**7.** A train travels 92.4 Km/h. How many metres will it travel in 10 minutes?

(a) 14500 m (b) 15400 m
(c) 15200 m (d) None of these

**8.** The distance of the sun from the earth is one hundred and $\frac{4}{3}$ million four hundred thousand kilometres and light travels from the former to the later in 7 minutes and 58 seconds. The velocity of light per second is:

(a) $3 \times 10^5$ Km/sec (b) $0.3 \times 10^5$ Km/sec
(c) $30 \times 10^5$ Km/sec (d) None of these

**9.** A train covers a distance in 50 minutes if it runs at a speed of 48 Km/h. The speed at which the train must run to reduce the time of journey to 40 minutes, will be:

(a) 70 Km/h (b) 80 Km/h
(c) 60 Km/h (d) None of these

**10.** The wheel of an engine is $3\frac{3}{4}$ metres in circumference and makes 4 revolutions in 2 seconds. The speed of the train is:

(a) 27 Km/h (b) 31 Km/h
(c) 35 Km/h (d) None of these

**11.** A person covers half of his journey at 30 Km/h and the remaining half at 20 Km/h. The average speed for the whole journey is:

(a) 25 Km/h (b) 28 Km/h
(c) 32 Km/h (d) None of these

**12.** Rajesh covers a certain distance by bus at 16 Km/h and returns at the starting point on a cycle at 9 Km/h. His average speed for the whole journey is:

(a) 13.54 Km/h (b) 11.52 Km/h
(c) 15.52 Km/h (d) None of these

**13.** A and B are two towns. A car goes from A to B at a speed of 64 Km/h and returns to A at a slower speed. If its average speed for the whole journey is 56 Km/h, it returned with speed:

(a) 52.54 Km/h (b) 47.74 Km/h
(c) 49.78 Km/h (d) None of these

**14.** A bicycle rider covers his onward journey from A to B at 10 Km/h and during the return journey from B to A he covers the same distance at 8 Km/h. If he finishes the onward and return journey in $4\frac{1}{2}$ hours, then the total distance covered by him during the entire journey is:

(a) 30 Km (b) 40 Km
(c) 50 Km (d) None of these

**15.** On a tour, a man travels at the rate of 64 Km an hour for the first 160 Km, then travels the next 160 Km at the rate of 80 Km an hour. The average speed in Km per hour for the first 320 Km of the tour is:

(a) 81.13 Km/h (b) 73.11 Km/h
(c) 71.11 Km/h (d) None of these

**16.** A car completes a journey in 6 hours. It covers half the distance at 50 Km/h and the rest at 70 Km/h The length of the journey is:

(a) 165 Km (b) 175 Km
(c) 185 Km (d) None of these

**17.** Rakesh sets out to cycle from Delhi to Mathura and at the same time Suresh starts from Mathura to Delhi. After passing each other, they complete their journeys in 9 and 16 hours, respectively. At what speed does Suresh cycle if Rakesh cycles at 16 Km per hour?

(a) 12 Km/h (b) 16 Km/h
(c) 14 Km/h (d) None of these

**18.** A train travels 225 Km in 3·5 hours and 370 Km in 5 hours. Find out the average speed of train.

(a) 80 Km/h (b) 60 Km/h
(c) 70 Km/h (d) None of these

**19.** A man walks 6 Km at a speed of $1\frac{1}{2}$ Km/h, runs 8 Km at a speed of 2 Km/h and goes by bus another 32 Km. Speed of the bus is 8 Km/h. If the speed of the bus is considered as the speed of the man, find the average speed of the man.

(a) $4\frac{5}{6}$ Km/h (b) $3\frac{5}{6}$ Km/h
(c) $5\frac{7}{6}$ Km/h (d) None of these

**20.** A car during its journey travels 30 minutes at a speed of 40 Km/h, another 45 minutes at a speed of 60 Km/h, and 2 hours at a speed of 70 Km/h. The average speed of the car is:

(a) 63 Km/h (b) 65 Km/h
(c) 70 Km/h (d) None of these

**21.** By walking at $\frac{3}{4}$ of his usual speed, a man reaches office 20 minutes later than usual. His usual time is:

(a) 65 minutes (b) 60 minutes
(c) 70 minutes (d) None of these

**22.** Two men start together to walk a certain distance, one at 4 Km/h and another at 3 Km/h. The former arrives half an hour before the latter. Find out the distance.

(a) 6 Km (b) 9 Km
(c) 8 Km (d) None of these

**23.** A car starts from A for B travelling 20 Km an hour. $1\frac{1}{2}$ hours later another car starts from A and travelling at the rate of 30 Km an hour reaches B $2\frac{1}{2}$ hours before the first car. Find the distance from A to B.

(a) 280 Km (b) 260 Km
(c) 240 Km (d) None of these

**24.** Mohan walks from Tilak Nagar to Moti Nagar and back in a certain time at the rate of $3\frac{1}{2}$ Km/h. But, if he had walked from Tilak Nagar to Moti Nager at the rate of 3 Km/h and back from Moti Nagar to Tilak Nagar at the rate of 4 Km/h., he would have taken 10 minutes longer. The distance between Tilak Nagar and Moti Nagar is:

(a) 28 Km (b) 32 Km
(c) 24 Km (d) None of these

**25.** A train does a non-stop journey for 8 hours. If it had travelled 5 Km an hour faster, it would have done the journey in 6 hours 40 min. What is its lowest speed?

(a) 35 Km/h (b) 25 Km/h
(c) 40 Km/h (d) None of these

**26.** Without any stoppage, a person travels a certain distance at an average speed of 42 Km/h and with stoppages he covers the same distance at an average speed of 28 Km/h. How many minutes per hour does he stop?

(a) 25 minutes (b) 30 minutes
(c) 20 minutes (d) None of these

**27.** A train is running at a uniform speed of 60 Km/h. It passes a railway platform in 15 seconds. If the length of the platform is 130 m, then the length of the train is:

(a) 160 m (b) 120 m
(c) 140 m (d) None of these

**28.** A train passes through a telegraph post in 9 seconds moving at a speed of 54 Km per hour. The length of the train is:

(a) 135 metres (b) 145 metres
(c) 125 metres (d) None of these

**29.** A 135 m long train is running with a speed of 54 Km per hour. In what time will it pass a telegraph post?

(a) 11 seconds (b) 9 seconds
(c) 7 seconds (d) None of these

**30.** A train 160 metres long passes a standing man in 18 seconds. The speed of the train is:

(a) 35 Km/h (b) 45 Km/h
(c) 32 Km/h (d) None of these

**31.** A 280 m long train is moving at a speed of 60 Km/h. The time taken by the train to cross a platform 220 m long is:

(a) 30 seconds (b) 40 seconds
(c) 60 seconds (d) 20 seconds

**32.** A train 50 m long passes a platform 100 m long in 10 seconds. The speed of the train in m/s is:

(a) 25 seconds (b) 15 seconds
(c) 35 seconds (d) None of these

**33.** A train 300 metres long is running at a speed of 90 Km/h. How many seconds will it take cross a 200 metres long train running in the opposite direction at a speed of 60 Km/h?

(a) 70 seconds (b) 60 seconds
(c) 50 seconds (d) None of these

**34.** Two trains are running in opposite directions with the same speed. If the length of each train is 135 metres and they cross each other in 18 seconds, the speed of each train is:

(a) 29 Km/h (b) 35 Km/h
(c) 27 Km/h (d) None of these

**35.** A train 150 m long is running at 95 Km/h. How much time will it take to pass a man moving in the same direction at 5 Km/h?

(a) 9 seconds (b) 6 seconds
(c) 7 seconds (d) None of these

**36.** A train 100 metres long takes $3\frac{3}{5}$ seconds to cross a man walking at the rate of 6 Km/h in a direction opposite to that of the train. Find the speed of the train.

(a) 76 Km/h (b) 94 Km/h
(c) 86 Km/h (d) None of these

**37.** Two trains are moving in the same direction at 50 Km/h and 30 Km/h. The faster train crosses a man in the slower train in 18 seconds. Find the length of the faster train.

(a) 120 m (b) 110 m
(c) 100 m (d) None of these

**38.** Two trains, 130 m and 110 m long, while going in the same direction, the faster train takes one minute to pass the other completely. If they are moving in opposite direction, they pass each other completely in 3 seconds. Find the speed of each train.

(a) 42 m/s 38 m/s (b) 38 m/s 36 m/s
(c) 36 m/s 42 m/s (d) None of these

**39.** Two trains, each of length 90 metres, run on parallel tracks. When running in the same direction, the faster train passes the slower train completely in 18 seconds, but when they are running in opposite directions approaching each other at the same speeds as before they cross each other in 9 seconds. Find the speed of each train.

(a) 9 m/s 15 m/s (b) 7 m/s 5 m/s
(c) 15 m/s 5 m/s (d) None of these

**40.** A train leaves the station at 5 am at 60 Km/h. Another train leaves the same station at 6.30 am at 75 Km/h and travels in the direction of the first train. At what time and at what distance from the station will they meet?

(a) 12.30. am 450 Km (b) 1.30 pm 375 Km
(c) 11.30 am 425 Km (d) None of these

**41.** Two stations A and B are 100 Km apart on a straight line. One train starts from A at 7 am and travels towards B at 20 Km/h speed. Another train starts from B at 8 am and travels towards A at 25 Km/h speed. At what time will they meet?

(a) 10.30 am (b) 11 am
(c) 10 am (d) None of these

**42.** A train starts from station A at 9 am travels at 50 Km/h towards station B, 210 Km away. Another train starts from station B at 11 am and travels at 60 Km/h towards station A. At what distance from A, will they meet?

(a) 150 Km (b) 200 Km
(c) 250 Km (d) None of these

**43.** Two trains start at the same time from Mumbai and Pune and proceed towards each other at the rate of 60 Km and 40 Km per hour, respectively. When they meet, it is found that one train has travelled 20 Km more than the other. Find the distance between Mumbai and Pune.

(a) 150 Km (b) 100 Km
(c) 120 Km (d) None of these

**44.** A car covers four successive three Km stretches at speed of 10 Km/h, 20 Km/h, 30 Km/h and 60 Km/h. respectively. Its average speed over this distance is:

(a) 10 Km/h (b) 20 Km/h
(c) 30 Km/h (d) 25 Km/h

**45.** Two men A and B walk from P to Q at a distance of 21 Km at rates 3 and 4 Km an hour, respectively. B reaches Q and returns immediately and meets A at R. The distance from P to R is:

(a) 14 Km (b) 20 Km
(c) 16 Km (d) 18 Km

**46.** A boy takes as much time in running 12 metres as a car takes in covering 36 metres. The ratio of the speeds of the boy and the car is:

(a) 1:3 (b) 1:2
(c) 2:3 (d) 2:5

**47.** A and B are two stations. A train goes from A to B at 64 Km/h and returns to A at a slower speed. If its average speed for the whole journey is 56 Km/h, at what speed did it return?

(a) 48 Km/h (b) 49.77 Km/h
(c) 30 Km/h (d) 47.46 Km/h

**48.** Excluding stoppages, the speed of a bus is 54 Km/h and including stoppages, it is 45 Km/h. For how many minutes does the bus stop per hour?

(a) 9 (b) 10
(c) 12 (d) 20

**49.** Two boys jointly begin to write a booklet containing 817 lines. The first boy starts with the first line, he writes 200 lines an hour. The starts with the last line, then writes line 816 and so on, backwards proceeding at the rate of 150 lines an hour. They will meet on:

(a) 467th line (b) 466th line
(c) 460th line (d) 472th line

**50.** Ramesh sees a train passing over a 1 Km long bridge. The length of the train is half that of the bridge. If the train passes the bridge in 2 minutes, the speed of the train is:

(a) 45 Km/h (b) 43 Km/h
(c) 50 Km/h (d) None of these

**51.** A bullock cart has to cover a distance of 80 Km in 10 hours. If it covers half of the journey in $\frac{3}{5}$ the time, what should be its speed to cover the remaining distance in the time left?

(a) 8 Km/h (b) 20 Km/h
(c) 6.4 Km/h (d) 10 Km/h

**52.** Amit started cycling along the boundaries of a square field from cover point A. After half an hour, he reached the corner point C, diagonally opposite to A. If his speed was 8 Km/h, what is the area of the field in square Km?

(a) 64 (b) 8
(c) 4 (d) Cannot be determined

**53.** A 100 metres long train completely passes a man walking in the same direction at 6 Km/h in 5 seconds and also a car travelling in the same direction in 6 seconds. At what speed was the car travelling?

(a) 18 Km/h (b) 48 Km/h
(c) 24 Km/h (d) 30 Km/h

**54.** A motor cyclist travels from Mumbai to Pune, a distance of 192 Kms, at an average speed of 32 Km/h Another man starts from Mumbai by travelling in a car, $2\frac{1}{2}$ hours after the cyclist and reaches Pune half an hour earlier. What is the ratio of the speeds of the motor cycle and the car?

(a) 1:2 (b) 1:3
(c) 10:27 (d) 5:4

**55.** Two trains are running in opposite directions with speed of 62 Km/h and 40 Km/h, respectively. If the length of one train is 250 metres and they cross each other in 18 seconds,then the length of the other train is:

(a) 145 m (b) 230 m
(c) 260 m (d) Cannot be determined

**56.** A train speeds past a pole in 15 seconds and speeds past a 100 metres long platform in 25 seconds. Its length in metres is:

(a) 200 (b) 150
(c) 50 (d) Data inadequate

**57.** A 150 metres long train takes 10 seconds to pass over another 100 metres long train coming from the opposite direction. If the speed of the first train is 30 Km/h, the speed of the second train is:

(a) 54 Km/h (b) 60 Km/h
(c) 72 Km/h (d) 36 Km/h

**58.** A person sets to cover a distance of 12 Km in 45 minutes. If he covers $\frac{3}{4}$ of the distance in $\frac{2}{3}$ time, what should be his speed to cover the remaining distance in the remaining time?

(a) 16 Km/h (b) 8 Km/h
(c) 12 Km/h (d) 14 Km/h

**59.** A 110 metres long train passes a man walking at the speed of 6 Km/h, against it in 6 seconds. The speed of the train in Km/h is:

(a) 60 Km/h (b) 45 Km/h
(c) 50 Km/h (d) 55 Km/h

**60.** If a 110 metres long train passes a man walking at a speed of 6 Km/h against it in 6 seconds, it will pass another man walking at the same speed in the same direction in time of:

(a) $9\frac{1}{3}$ seconds (b) $10\frac{2}{3}$ seconds
(c) 8 seconds (d) $7\frac{1}{3}$ seconds

**61.** A man performs $\frac{2}{15}$ of the total journey by rail, $\frac{9}{20}$ by tonga and the remaining 10 Km on foot. The total journey is:

(a) 15.6 Km (b) 12.8 Km
(c) 16.4 Km (d) 24 Km

## EXERCISE-2
## (BASED ON MEMORY)

**1.** Raman drove from home to a neighbouring town at the speed of 50 Km/h and on his returning journey. He drove at the speed of 45 Km/h and, also took an hour longer to reach home. What distance did he cover each way?

(a) 450 Km (b) 225 Km
(c) 900 Km (d) 500 Km
(e) None of these

**[SBI PO Examination, 2008]**

**2.** Pratibha covers a distance of 24 Km at the speed of 8 Km/h and a distance of 18 Km at the speed of 9 Km/h. Further, she coveres a distance of 12 Km at the speed of 3 Km/h. What is her average speed in covering the whole distance?

(a) 8 Km/h (b) 5.5 Km/h
(c) 3 Km/h (d) 6 Km/h
(e) None of these

**[NABARD PO Examination, 2008]**

**3.** A man walks at the speed of 5 Km/h and runs at the speed of 10 Km/h. How much time will the man require to cover the distance of 28 Km, if he coveres half (first 14 Km) of his journey walking and half his journey running?

(a) 8.4 hours (b) 6 hours
(c) 5 hours (d) 4.2 hours
(e) None of these

**[Allahabad Bank SO Examination, 2007]**

**4.** A car covers the first 35 Km of its journey in 45 minutes and the remaining 69 Km in 75 minutes. What is the average speed of the car?

(a) 42 Km/h (b) 50 Km/h
(c) 52 Km/h (d) 60 Km/h
(e) None of these

**[Bank of Baroda PO Examination, 2007]**

**5.** Milind takes as much time in running 15 metres as a car takes in covering 40 metres. What will be the distance covered by Milind during the time the car covers 2 Km?

(a) 1000 metres (b) 600 metres
(c) 650 metres (d) 750 metres
(e) None of these

**[OBC PO Examination, 2007]**

**6.** A 180 metre long train crosses a platform of equal length in 18 seconds. What is the speed of the train?

(a) 22 m/s (b) 10 m/s
(c) 15 m/s (d) 18 m/s
(e) None of these

**[CBI PO Examination, 2007]**

**7.** A car covers the first 30 Km of its journey in 45 minutes and the remaining 25 Km in 35 minutes. What is the average speed of the car?

(a) 40 Km/h (b) 64 Km/h
(c) 49 Km/h (d) 48 Km/h
(e) None of these

**[Andhra Bank PO Examination, 2006]**

**8.** A train passes two bridges of lengths 800 m and 400 m in 100 seconds and 60 seconds. The length of the train is:

(a) 80 m (b) 90 m
(c) 200 m (d) 150 m

**[SSC (GL) Prel. Examination, 2005]**

**9.** A train running at $\frac{7}{11}$ of its normal speed reached a place in 22 hours. How much time could be saved if the train would have run at its normal speed?

(a) 14 hours (b) 7 hours
(c) 8 hours (d) 16 hours

**[SSC (GL) Prel. Examination, 2005]**

**10.** A train, 150 m long, takes 30 seconds to cross a bridge 500 m long. How much time will the train take to cross a platform 370 m long?

(a) 36 seconds (b) 30 seconds
(c) 24 seconds (d) 18 seconds

**[SSC (GL) Prel. Examination, 2005]**

**11.** If a train, with a speed of 60 Km/h, crosses a pole in 30 seconds, then the length of the train (in metres) is:

(a) 1000 (b) 900
(c) 750 (d) 500

**[SSC (GL) Prel. Examination, 2005]**

**12.** A 120 metre long train is running at a speed of 90 Km/h. It will cross a 230 m long railway platform in:

(a) $4\frac{4}{5}$ seconds (b) $9\frac{1}{5}$ seconds
(c) 7 seconds (d) 14 seconds

**[SSC (GL) Prel. Examination, 2005]**

**13.** A train is moving at a speed of 180 Km/h. Its speed (in metres per second) is:

(a) 5 (b) 40
(c) 30 (d) 50

**[SSC (GL) Prel. Examination, 2005]**

**14.** A car travels 10 metres in a second. Find its speed in Km/h.

(a) 40 (b) 32
(c) 48 (d) 36

**[SSC (GL) Prel. Examination, 2002]**

**15.** A man can reach a certain place in 30 hours. If he reduces his speed by $\frac{1}{15}$, he goes 10 Km less in that time. Find his speed per hour.

(a) 6 Km/h (b) $5\frac{1}{2}$ Km/h
(c) 4 Km/h (d) 5 Km/h

**[SSC (GL) Prep. Examination, 2002]**

**16.** A 120 m long train takes 10 seconds to cross a man standing on a platform. What is the speed of the train?

(a) 12 m/s (b) 10 m/s
(c) 15 m/s (d) 20 m/s

**[SSC (GL) Prel. Examination, 2002]**

**17.** A train passes a man standing on a platform in 8 seconds and also crosses the platform, which is 264 metres long, in 20 seconds. The length of the train (in metres) is:

(a) 188 m (b) 176 m
(c) 175 m (d) 96 m

**[SSC (GL) Prel. Examination, 2002]**

**18.** A train moves at a of 180 Km/h. Its speed (in metre per second) is:

(a) 5 m/s (b) 40 m/s
(c) 30 m/s (d) 50 m/s

**[SSC (GL) Prel. Examination, 2002]**

**19.** A car travelling at $\frac{5}{7}$ of its actual speed covers 42 Km is 1 hour 40 minutes 48 second. Find out the actual speed of the car.

(a) $17\frac{6}{7}$ Km/h (b) 35 Km/h
(c) 25 Km/h (d) 30 Km/h

**[SSC (GL) Prel. Examination, 2002]**

**20.** A train, 120 metres long, passes a telegraph post in 6 seconds. Find out the speed of the train.

(a) 60 Km/h (b) 72.5 Km/h
(c) 80 Km/h (d) 72 Km/h

**[SSC Prel. (GL) Examination, 2002]**

**21.** A trains passes a telegraph post in 8 seconds and a 264 m long bridge in 20 seconds. What is the length of the train?

(a) 180 m (b) 176 m
(c) 164 m (d) 158 m

**[SSC (GL) Prel. Examination, 2002]**

**22.** A 800 metres long train is running at a speed of 78 Km/h. If it crosses a tunnel in 1 minute, then the length of the tunnel (in metres) is:

(a) 700 m (b) 500 m
(c) 400 m (d) 600 m

**[SSC (GL) Prel. Examination, 2003]**

**23.** A man covered a certain distance at some speed. Had he moved 3 Km/h faster, he would have taken 40 minutes less. If he had moved 2 Km/h slower, he would have taken 40 minutes more. The distance (in Km) is:

(a) 20 Km (b) 35 Km
(c) $36\frac{2}{3}$ Km (d) 40 Km

**[SSC (GL) Prel. Examination, 2003]**

**24.** Two trains, one 160 m and other 140 m long, are running in opposite directions on parallel rails. The first train at 77 Km/h and the other train at 67 Km. How long will they take to cross each other.

(a) 7 seconds (b) $7\frac{1}{2}$ seconds
(c) 6 seconds (d) 10 seconds

**[SSC (GL) Prel. Examination, 2003]**

**25.** Two trains are running in opposite directions with same speed. If the length of each train is 120 metres and they cross each other in 12 seconds, the speed of each train (in Km/h) is:

(a) 72 Km/h (b) 10 Km/h
(c) 36 Km/h (d) 18 Km/h

**[SSC (GL) Prel. Examination, 2003]**

**26.** In what time a 100 metres long train will cross an electric pole if its speed be 144 Km/h?

(a) 2.5 seconds (b) 5 seconds
(c) 12.5 seconds (d) $3\frac{5}{4}$ seconds

**[SSC (GL) Prel. Examination, 2003]**

**27.** A car travelling at speed of 40 Km/h can complete a journey in 9 hours. How long will it take to travel the same distance with a speed of 60 Km/h?

(a) 6 hours (b) 3 hours
(c) 4 hours (d) $4\frac{1}{2}$ hours

**[SSC (GL) Prel. Examination, 2003]**

**28.** A train running at speed of 120 Km/h crosses a signal post in 15 seconds. What is the length of the train in metres?

(a) 300 m (b) 200 m
(c) 500 m (d) Cannot be determined
(e) None of these

**[BSRB Bhopal PO Examination, 2000]**

**29.** A car finishes a journey in 10 hours at the speed of 80 Km/h. If the same distance is to be covered in 8 hours, then how much speed would the train gather?

(a) 8 Km/h (b) 10 Km/h
(c) 12 Km/h (d) 16 Km/h
(e) None of these

**[BSRB Delhi PO Examination, 2000]**

**30.** Train 'A' leaves Mumbai Central for Lucknow at 11:00 am, running at the speed of 60 Km/h. Train 'B' leaves Mumbai Central for Lucknow by the same route at 2:00 pm on the same day, running at the speed of 72 Km/h. At what time will the two trains meet each other?

(a) 2 am on the next day
(b) 5 am on the next day
(c) 5 pm on the next day
(d) 2 pm on the next day
(e) None of these

**[BSRB Patna PO Examination, 2001]**

**31.** Trains, A and B are travelling on the same route heading towards the same destination. Train B has already covered a distance of 220 Km before train A started. The two trains meet each other 11 hours after the start of train A. Had the trains been travelling towards each other (from a distance of 220 Km), they would have met after one hour. What is the speed of train B in Km/h?

(a) 100 Km/h (b) 180 Km/h
(c) 116 Km/h (d) Data inadequate
(e) None of these

**[SBI PO Examination, 2001]**

**32.** The speed of a car increases by 2 Km after every hour. If the distance travelled in the first hour was 35 Km, then what was the total distance travelled in 12 hours?

(a) 522 Km (b) 456 Km
(c) 556 Km (d) 482 Km
(e) None of these

**[Bank of Maharashtra PO Examination, 2003]**

**33.** To get to a business meeting, John drove $m$ miles in hours, and arrived 1/2 hour early. At what rate should he have driven to arrive exactly on time?

(a) $\frac{m}{2h}$ (b) $\frac{2m}{2h+1}$

(c) $\frac{2m}{2h-1}$ (d) $\frac{2m-h}{2h}$

**[REC Tiruchirapalli Examination, 2003]**

**34.** A train, 300 m long, passed a man, walking along the line in the same direction at the rate of 3 Km/h in 33 s. The speed of the train is:

(a) 30 Km/h (b) 32 Km/h

(c) $32\frac{8}{11}$ Km/h (d) $35\frac{8}{11}$ Km/h

**[SSC (GL) Examination, 2010]**

**35.** Buses start from a bus terminal with a speed of 20 Km/h at an intervals of 10 mins. What is the speed of a man coming from the opposite direction towards the bus terminal if he meets the buses at an intervals of 8 mins?

(a) 3 Km/h (b) 4 Km/h
(c) 5 Km/h (d) 7 Km/h

**[SSC (GL) Examination, 2010]**

**36.** A 180 m long train crosses another 270 m long train running in the opposite direction in 10.8 seconds. If the speed of the first train is 60 Km/h, what is the speed of the second train in Km/h?

(a) 80 (b) 90
(c) 150 (d) Cannot be determined

**[Gramin Bank U.P. (SO) Examination, 2012]**

**37.** Paschim Express left Delhi for Mumbai at 14:30 hours travelling at a speed of 60 Km/h. August Kranti Express left Delhi for Mumbai on the same day at 16:30 hours travelling at a speed of 80 Km/h. How far away from Delhi will the two trains meet (stop-pages excluded)?

(a) 500 Km (b) 480 Km
(c) 360 Km (d) 240 Km

**[UPPCS Examination, 2012]**

**38.** A man starts from his home and walks 10 m towards South. Then he turns right and walks 6 Km, again he turns right and goes 10 Km. Finally, he turns right and walks 5 Km. At what distance is he from his starting point?

(a) 31 Km (b) $2\sqrt{101}$ Km

(c) 1 Km (d) $\sqrt{125}+\sqrt{136}$ Km

**[UPPCS Examination, 2012]**

**39.** Car A runs at the speed of 65 Km/h and reaches its destination in 8 hours. Car B runs at the speed of 70 Km/h and reaches its destination in 4 hours. What is the respective ratio of distances covered by Car A and Car B?

(a) 11:7 (b) 7:13
(c) 13:7 (d) 7:11

**[Syndicate Bank PO Examination, 2010]**

**40.** Deepa drives a bike at an average speed of 30 Km/h and reach her destination in 6 hours. Hema covers that distance in 4 hours. If Deepa increases her average speed by 10 Km/h and Hema increases her average speed by 5 Km/h, then what will be the difference in time taken by them to reach their destination?

(a) 54 minutes (b) 1 hour
(c) 40 minutes (d) 45 minutes

**[Syndicate Bank PO Examination, 2010]**

**41.** The ratio between the speed of a train and a car is 16:15. Also, a bus covered a distance of 480 Km in 8 hours. The speed of the bus is $\frac{3}{4}$ the speed of the train. How much distance will the car cover in 6 hours?

(a) 450 Km (b) 480 Km
(c) 360 Km (d) Cannot be determined

**[Bank of Baroda PO Examination, 2010]**

**42.** A 320 m long train moving at an average speed of 120 Km/h crosses a platform in 24 seconds. A man crosses the same platform in 4 minutes. What is the speed of man in m/s?

(a) 2.4 (b) 1.5
(c) 1.6 (d) 2.0

**[Bank of Baroda PO Examination, 2011]**

**43.** The average speed of a car is $1\frac{4}{5}$ times the average speed of a bus. A tractor covers 575 Km in 23 hours. How much distance will the car cover in 4 hours if the speed of the bus is twice speed of the tractor?

(a) 340 Km (b) 480 Km
(c) 360 Km (d) 450 Km

**[Corporation Bank PO Examination, 2011]**

**44.** Train A crosses a pole in 25 seconds and another Train B crosses a pole in 1 minute and 15 seconds. Length of Train A is half the length of Train B. What is the respective ratio between the speeds of Train A and Train B?

(a) 3:2 (b) 3:4
(c) 4:3 (d) Cannot be determined

**[Union Bank of India PO Examination, 2011]**

**45.** A 240 m long train takes 40 seconds longer to cross a platform twice its length than the time it takes to cross a pole at the same speed. What is the speed of the train?

(a) 6 m/s (b) 24 m/s
(c) 48 m/s (d) 12 m/s

**[Dena Bank PO Examination, 2008]**

**46.** A 200 m long train crosses a platform of double its length in 36 seconds. What is the speed of the train in Km/h?

(a) 60 Km/h (b) 48 Km/h
(c) 64 km/h (d) 66 Km/h

**[SBI PO Examination, 2008]**

**47.** A man walked at a speed of 4 Km/h from point A to B and come back from point B to A at the speed of 6 Km/h. What would be the ratio between the time taken by man in walking from point A to B to point B to A?

(a) 5:3 (b) 2:3
(c) 2:1 (d) 4:3

**[Corporation Bank PO Examination, 2009]**

**48.** A bus started its journey from Ramgarh and reached Devgarh in 44 minutes with its average speed of 50 Km/h. If the average speed of the bus is increased by 5 Km/h, then much time will it take to cover the same distance?

(a) 40 minutes (b) 38 minutes
(c) 36 minutes (d) 31 minutes

**[Corporation Bank PO Examination, 2009]**

**49.** The bus fare for one person is ₹420 from Agra to Aligarh and train fare between the same places for one person is equal to $\frac{3}{4}$ the bus fare for two persons between the same places. What is the total fare paid by 2 persons traveling by bus and 4 persons traveling by train between the two places?

(a) ₹3360 (b) ₹3460
(c) ₹3440 (d) ₹3406

**[CBI (PO) Examination, 2010]**

**50.** Train A crosses a stationary Train B in 50 s and a pole in 20 s with the same speed. The length of Train A is 240 metre. What is the length of the stationary Train B?

(a) 360 m (b) 260 m
(c) 300 m (d) Cannot be determined

**[CBI (PO) Examination, 2010]**

**51.** A bike covers a certain distance at the speed of 64 Km/h in 8 hours. If the bike was to cover the same distance in approximately 6 hours, at what approximate speed should the bike travel?

(a) 80 Km/h (b) 85 Km/h
(c) 90 Km/h (d) 75 Km/h

**[Punjab National Bank PO Examination, 2010]**

**52.** If a distance of 50 m is covered in 1 minute, 90 m in 2 minutes and 130 m in 3 minutes find the distance covered in 15 minutes.

(a) 610 m (b) 750 m
(c) 1000 m (d) 650 m

**[SSC Examination, 2014]**

**53.** Three men step off together from the same spot. Their steps measure 63 cm, 70 cm and 77 cm, respectively. The minimum distance each should cover so that all can cover the distance in complete steps is:

(a) 9630 cm (b) 9360 cm
(c) 6930 cm (d) 6950 cm

**[SSC Examination, 2014]**

**54.** A man travelled a distance of 80 Km in 7 hours partly on foot at the rate of 8 Km/h and partly on bicycle at 16 Km/h. The distance travelled on the foot is:

(a) 32 Km (b) 48 Km
(c) 36 Km (d) 44 Km

**[SSC Examination, 2014]**

**55.** Two trains of equal length are running on parallel lines in the same direction at the rate of 46 Km/h and 36 Km/h. The faster train passes the slower train in 36 seconds. The length of each train is:

(a) 50 m (b) 72 m
(c) 80 m (d) 82 m

**[SSC Examination, 2014]**

**56.** A car driver leaves Bangalore at 8:30 am and expects to reach a place 300 Km from Bangalore at 12:30 pm. At 10:30 he finds that he has covered only 40% of the distance. By how much he has to increase the speed of the car in order to keep up his schedule?

(a) 45 Km/h (b) 40 Km/h
(c) 35 Km/h (d) 30 Km/h

**[SSC Examination, 2014]**

**57.** A train 300 m long is running with a speed of 54 Km/h. In what time will it cross a telephone pole?

(a) 20 seconds (b) 15 seconds
(c) 17 seconds (d) 18 seconds

**[SSC Examination, 2014]**

**58.** A man is walking at a speed of 10 Km/h. After every Km, he takes a rest for 5 minutes. How much time will he take to cover a distance of 5 Km?

(a) 60 minutes (b) 50 minutes
(c) 40 minutes (d) 70 minutes

**[SSC Examination, 2014]**

**59.** A train goes from Ballygunge to Sealdah at an average speed of 20 Km/h and comes back at an average speed of 30 Km/h. The average speed of the train for the whole journey is:

(a) 27 Km/h (b) 26 Km/h
(c) 25 Km/h (d) 24 Km/h

**[SSC Examination, 2013]**

**60.** A certain distance is covered by a cyclist at a certain speed. If a jogger covers half the distance in double the time, the ratio of the speed of the jogger to that of the cyclist is:

(a) 1:4 (b) 4:1
(c) 1:2 (d) 2:1

**[SSC Examination, 2013]**

**61.** The distance between places A and B is 999 Km. An express train leaves place A at 6:00 am and runs at a speed of 55.5 Km/h. The train stops on the way for 1 hour 20 minutes. It reaches B at:

(a) 1:20 am (b) 12:00 pm
(c) 6:00 pm (d) 11:00 pm

**[SSC Examination, 2013]**

**62.** If a boy walks from his house to school at the rate of 4 Km/h, he reaches the school 10 minutes earlier than the scheduled time. However, if he walks at the rate of 3 Km/h, he reaches 10 minutes late. Find the distance of the school from his house.

(a) 5 Km (b) 4 Km
(c) 6 Km (d) 4.5 Km

**[SSC Examination, 2013]**

**63.** Two trains are running at a speed of 40 Km/h and 20 Km/h, respectively in the same direction. The fast train completely passes a man sitting in the slow train in 5 seconds. The length of the fast train is:

(a) $23\frac{2}{9}$ m (b) 27 m

(c) $27\frac{7}{9}$ m (d) 23 m

**[SSC Examination, 2013]**

**64.** A boy started from his house by bicycle at 10:00 am at a speed of 12 Km/h. His elder brother started after 1 hour 15 minutes by scooter along the same path and caught him at 1:30 pm. The speed of the scooter was (in Km/h)

(a) 4.5 (b) 36

(c) $18\frac{2}{3}$ (d) 9

**[SSC Assistant Grade III Examination, 2013]**

**65.** If a train runs at 40 Km/h, it reaches its destination late by 11 minutes, but if it runs at 50 Km/h, it is late by 5 minutes only. Find, the correct time for the train to complete its journey.

(a) 19 minutes (b) 20 minutes
(c) 21 minutes (d) 18 minutes

**[SSC Assistant Grade III Examination, 2012]**

**66.** P and Q are 27 Km away. Two trains with speeds of 24 Km/h and 18 Km/h respectively start simultaneously from P and Q and travel in the same direction. They meet at a point R beyond Q. Distance QR is:

(a) 126 Km (b) 81 Km
(c) 48 Km (d) 36 Km

**[SSC Examination, 2012]**

**67.** Two trains, A and B, start from stations X and Y towards Y and X respectively. After passing each other, they take 4 hours 48 minutes and 3 hours 20 minutes to reach Y and X respectively. If train A is moving at 45 Km/h, then the speed of the train B is:

(a) 60 Km/h (b) 64.8 Km/h
(c) 54 Km/h (d) 37.5 Km/h

**[SSC Examination, 2012]**

**68.** A train covers a distance between station A and station B in 45 minutes. If the speed of the train is reduced by 5 Km/h, then the same distance is covered in 48 minutes. The distance between stations A and B is:

(a) 60 Km (b) 64 Km
(c) 80 Km (d) 55 Km

**[SSC Examination, 2012]**

**69.** A car covers $\frac{1}{5}$ of the distance from A to B at the speed of 8 Km/h, $\frac{1}{10}$ of the distance at 25 Km/h and the remaining at the speed of 20 Km/h. Find the average speed of the whole journey.

(a) 12.625 Km/h (b) 13.625 Km/h
(c) 14.625 Km/h (d) 15.625 Km/h

**[SSC Examination, 2011]**

**70.** Walking at 3 Km/h, Pintu reaches his school 5 minutes late. If he walks at 4 Km/h he will be 5 minutes early. The distance of Pintu's school from his house is:

(a) $1\frac{1}{2}$ Km (b) 2 Km
(c) $2\frac{1}{2}$ Km (d) 5 Km

**[SSC Examination, 2011]**

**71.** A man driving at $\frac{3}{4}$ of his original speed reaches his destination 20 minutes later than the usual time. Then the usual time is:

(a) 45 minutes (b) 60 minutes
(c) 75 minutes (d) 120 minutes

**[SSC Examination, 2011]**

**72.** If A travels to his school from his house at the speed of 3 Km/h, then he reaches the school 5 minutes late. If he travels at the speed of 4 Km/h, he reaches the school 5 minutes earlier than school time. The distance of his school from his house is:

(a) 1 Km (b) 2 Km
(c) 3 Km (d) 4 Km

**[SSC Examination, 2010]**

**73.** Two places A and B are 100 Km apart on a highway. One car starts from A and another from B at the same time. If the cars travel in the same direction at a constant speed, they meet in 5 hours. If the cars travel towards each other, they meet in 1 hour. What is the speed of the car running faster?

(a) 60 Km/h (b) 50 Km/h
(c) 40 Km/h (d) 32 Km/h

**[SSC Examination, 2010]**

**74.** A train travelling with a speed of 60 Km/h catches another train travelling in the same direction and then leaves it 120 m behind in 18 seconds. The speed of the second train is:

(a) 26 Km/h (b) 35 Km/h
(c) 36 Km/h (d) 63 Km/h

**[SSC Examination, 2010]**

**75.** It takes 24 seconds for a train travelling at 93 Km/h to cross entirely another train half its length travelling in opposite direction at 51 Km/h. It passes a bridge in 66 seconds. What is the length of the bridge? (in metres)

(a) 1065 (b) 1600
(c) 1705 (d) 1580
(e) None of these

**[IBPS PO/MT Examination, 2014]**

**76.** A person travels from P to Q at a speed of 40 Km/h and returns to Q by increasing his speed by 50%. What is his average speed for both the trips?

(a) 36 Km/h (b) 45 Km/h
(c) 48 Km/h (d) 50 Km/h
(e) None of these

**[IBPS PO/MT Examination, 2013]**

**77.** The fare of a bus is ₹$X$ for the first five kilometres and ₹13 per kilometre thereafter. If a passenger pays ₹2402 for a journey of 187 kilometres, what is the value of $X$?

(a) ₹29 (b) ₹39
(c) ₹36 (d) ₹31
(e) None of these

**[IBPS PO/MT Examination, 2012]**

**78.** What is the speed of the train in Km/h?

**Statements:**

**I.** The train crosses an '$x$' meter-long platform in '$n$' seconds.
**II.** The length of the train is '$y$' meters.
**III.** The train crosses a signal pole in '$m$' seconds.

(a) Any two of the three
(b) Only II and III
(c) Only I and III
(d) All I, II and III
(e) Question cannot be answered even with information in all three statements.

**[SBI Associates Banks PO Examination, 2011]**

**79.** The average speed of a train is $1\frac{3}{7}$ times the average speed of a car. The car covers a distance of 588 Km in 6 hours. How much distance will the train cover in 13 hours?

(a) 1750 Km (b) 1760 Km
(c) 1720 Km (d) 1850 Km
(e) None of these

**[IOB PO Examination, 2011]**

**80.** A car covers first 39 Km of its journey in 45 minutes and the remaining 25 Km in 35 minutes. What is the averagespeed of the car?

(a) 40 Km/h (b) 64 Km/h
(c) 49 Km/h (d) 48 Km/h
(e) None of these

**[Andhra Bank PO Examination, 2011]**

**81.** The ratio of the speed of a bus to that of a train is 15:27. Also, a car covered a distance of 720 Km in 9 hours. The speed of the bus is 3/4 the speed of the car. How much distance will the train cover in 7 hours?

(a) 760 Km (b) 756 Km
(c) 740 Km (d) Cannot be determined
(e) None of these

**[Allahabad Bank PO Examination, 2011]**

**82.** The call rate of a SIM of Company A is one paisa forevery three seconds. Another SIM of Company B charges 45 paisa per minute. A man talked for 591 secondsfrom the SIM of Company A and 780 seconds from the SIM of Company B. What would be the total amount hespent?

(a) ₹7.80 (b) ₹7.40
(c) ₹7.46 (d) ₹7.82
(e) ₹8.46

**[Allahabad Bank PO Examination, 2011]**

**83.** A 280-metre-long train moving with an average speed of 108 Km/h crosses a platform in 12 seconds. A man crosses the same platform in 10 seconds. What is the speed ofthe man?

(a) 5 m/s (b) 8 m/s
(c) 12 m/s (d) Cannot be determined
(e) None of these

**[Allahabad Bank PO Examination, 2011]**

**84.** The average speed of a car is $1\frac{4}{5}$ times the average speed of a bus. A tractor covers 575 Km in 23 hours. How much distance will the car cover in 4 hours if the speed of the bus is twice the speed of the tractor?

(a) 340 Km (b) 480 Km
(c) 360 Km (d) 450 Km
(e) None of these

**[Corporation Bank PO Examination, 2011]**

**85.** A car covers the first 39 Km of its journey in 45 minutes and the remaining 25 Km in 35 minutes. What is the average speed of the car?

(a) 40 Km/h (b) 64 Km/h
(c) 49 Km/h (d) 48 Km/h
(e) None of these

**[Punjab and Sind Bank PO Examination, 2011]**

**86.** A man crosses a stationary bus in 18 seconds. The same bus crosses a pole in 4 seconds. What is the ratio of the speed of the bus to the speed of the man?

(a) 9:2 (b) 9:4
(c) 18:5 (d) Cannot be determined
(e) None of these

**[Syndicate Bank PO Examination, 2010]**

**87.** Train A crosses a stationary Train B in 50 seconds and a pole in 20 seconds with the same speed. The length of the Train A is 240 metres. What is the length of the stationary Train B?

(a) 360 metres (b) 260 metres
(c) 300 metres (d) Cannot be determined
(e) None of these

**[CBI PO Examination, 2010]**

**88.** The ratio of the speeds of a car, a jeep and a tractor is 3:5:2. The speed of the jeep is 250 percent the speed of the tractor, which covers 360 Km in 12 hours. What is the average speed of car and jeep together?

(a) 60 Km/h (b) 75 Km/h
(c) 40 Km/h (d) Cannot be determined
(e) None of these

**[CBI PO Examination, 2010]**

**89.** The ratio of the speeds of a car, a train and a bus is 5:9:4. The average speed of the car, the bus and the train is 72 Km/h together. What is the average speed of the car and the train together?

(a) 82 Km/h (b) 78 Km/h
(c) 84 Km/h (d) Cannot be determined
(e) None of these

**[Punjab and Sind Bank PO Examination, 2010]**

**90.** A 180-meter-long train crosses another 270-meter long train running from the opposite direction in 10.8 seconds. If the speed of the first train is 60 Km/h, what is the speed of the second train in Km/h?

(a) 80 (b) 90
(c) 150 (d) Cannot be determined
(e) None of these

**[Allahabad Bank PO Examination, 2010]**

**91.** Three friends A, B and C start running around a circular stadium and complete a single round in 24, 36 and 30 seconds, respectively. After how many minutes will they meet again at the starting point?

(a) 12 (b) 6
(c) 8 (d) 15
(e) 18

**[IDBI Bank PO Examination, 2009]**

**92.** A bus started its journey from Ramgarh and reached Devgarh in 44 minutes at an average speed of 50 Km/h. If the average speed of the bus is increased by 5 Km/h, how much time will it take to cover the same distance?

(a) 40 minutes (b) 38 minutes
(c) 36 minutes (d) 31 minutes
(e) 49 minutes

**[Corporation Bank PO Examination, 2009]**

**93.** A man walked at a speed of 4 Km/h from point A to B and came back from point B to A at the speed of 6 Km/h. What would be the ratio of the time taken by the man in walking from point A to B to that from point B to A?

(a) 5:3 (b) 2:3
(c) 2:1 (d) 4:3
(e) 3:2

**[Corporation Bank PO Examination, 2009]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (c) | **3.** (b) | **4.** (a) | **5.** (b) | **6.** (c) | **7.** (b) | **8.** (a) | **9.** (c) | **10.** (a) | **11.** (a) | **12.** (b) | **13.** (c) |
| **14.** (b) | **15.** (c) | **16.** (b) | **17.** (a) | **18.** (c) | **19.** (b) | **20.** (a) | **21.** (b) | **22.** (a) | **23.** (c) | **24.** (a) | **25.** (b) | **26.** (c) |
| **27.** (b) | **28.** (a) | **29.** (b) | **30.** (c) | **31.** (a) | **32.** (b) | **33.** (b) | **34.** (c) | **35.** (c) | **36.** (b) | **37.** (c) | **38.** (a) | **39.** (c) |
| **40.** (a) | **41.** (c) | **42.** (a) | **43.** (b) | **44.** (b) | **45.** (d) | **46.** (a) | **47.** (b) | **48.** (b) | **49.** (a) | **50.** (a) | **51.** (d) | **52.** (a) |
| **53.** (a) | **54.** (a) | **55.** (c) | **56.** (b) | **57.** (b) | **58.** (c) | **59.** (a) | **60.** (d) | **61.** (d) | | | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (d) | **3.** (d) | **4.** (c) | **5.** (d) | **6.** (e) | **7.** (e) | **8.** (c) | **9.** (c) | **10.** (c) | **11.** (d) | **12.** (d) | **13.** (d) |
| **14.** (d) | **15.** (d) | **16.** (a) | **17.** (b) | **18.** (d) | **19.** (b) | **20.** (d) | **21.** (b) | **22.** (b) | **23.** (d) | **24.** (b) | **25.** (c) | **26.** (a) |
| **27.** (a) | **28.** (c) | **29.** (e) | **30.** (b) | **31.** (a) | **32.** (e) | **33.** (c) | **34.** (d) | **35.** (c) | **36.** (b) | **37.** (b) | **38.** (c) | **39.** (c) |
| **40.** (a) | **41.** (a) | **42.** (d) | **43.** (c) | **44.** (a) | **45.** (d) | **46.** (a) | **47.** (b) | **48.** (a) | **49.** (a) | **50.** (a) | **51.** (b) | **52.** (a) |
| **53.** (c) | **54.** (a) | **55.** (a) | **56.** (d) | **57.** (a) | **58.** (b) | **59.** (d) | **60.** (a) | **61.** (a) | **62.** (b) | **63.** (c) | **64.** (c) | **65.** (a) |
| **66.** (b) | **67.** (c) | **68.** (a) | **69.** (d) | **70.** (b) | **71.** (b) | **72.** (b) | **73.** (a) | **74.** (c) | **75.** (a) | **76.** (c) | **77.** (c) | **78.** (e) |
| **79.** (e) | **80.** (d) | **81.** (b) | **82.** (d) | **83.** (b) | **84.** (c) | **85.** (d) | **86.** (a) | **87.** (a) | **88.** (a) | **89.** (c) | **90.** (b) | **91.** (b) |
| **92.** (a) | **93.** (e) | | | | | | | | | | | |

# EXPLANATORY ANSWERS

## Exercise-1

**1. (b)** Speed $= \dfrac{\text{Distance travelled}}{\text{Time taken}}$

$= \left(\dfrac{600}{5 \times 60}\right)$ m/s

$= \left(\dfrac{600}{5 \times 60} \times \dfrac{18}{5}\right)$ Km/h

$= 7.2$ Km/h.

**2. (c)** 80 Km/h means $\left(80 \times \dfrac{5}{18}\right)$ m/s.

∴ Required comparison is $80 \times \dfrac{5}{18}$ :10 or, 20:9.

**3. (b)** Mohan's speed $= \left(\dfrac{10.2}{3}\right)$ Km/h = 3.4 Km/h

∴ Distance covered by him in 5 hours
= (3.4 × 5) Km = 17 Km.

**4. (a)** Distance travelled by the train in 25 seconds at 72 Km/h.

$= 72 \times \dfrac{5}{18} \times 25 = 500$ m.

∴ Length of the Bridge = 500 − length of train
= 500 − 100 = 400 m.

**5. (b)** Let, the length of the train be $x$ m.

∴ Total distance covered by the train = ($x$ + 150) m.

Speed of the train = 60 Km/h $= 60 \times \dfrac{5}{18} = \dfrac{50}{3}$ m/s.

Since, Distance = Speed × time

∴ $x + 150 = \dfrac{50}{3} \times 18 = 300$

or, $x = 300 - 150 = 150$ m.

∴ Length of the train = 150 m.

**6. (c)** Distance of thunder-cloud
= distance travelled by sound in 10 seconds
= (330 × 10) metres = 3.3 Km.

**7. (b)** Speed of the train = 92.4 Km/h

$= \left(92.4 \times \dfrac{5}{18}\right)$ m/s

$= \dfrac{77}{3}$ m/s.

Distance covered in 10 minutes or 10 × 60 (= 600) seconds

$= \dfrac{77}{3} \times 600 = 15400$ m.

**8. (a)** Distance of the sun from the earth
$= (143 \times 10^6 + 400 \times 10^3)$ Km
$= 1434 \times 10^5$ Km.

Time taken by light to travel from the sun to the earth
= 7 × 60 + 58 = 478 seconds.

∴ Velocity of light $= \dfrac{1434 \times 10^5}{478}$

$= 3 \times 10^5$ Km/s.

**9. (c)** Distance travelled = Speed × Time $= \left(48 \times \dfrac{50}{60}\right)$
= 40 Km.

∴ Speed $= \dfrac{\text{Distance}}{\text{Time}} = \left(\dfrac{40 \times 60}{40}\right)$ Km/h
= 60 Km/h.

**10. (a)** Distance covered in 2 seconds $= \dfrac{15}{4} \times 4$
= 15 m.

∴ Speed $= \dfrac{\text{Distance}}{\text{Time}} = \dfrac{15}{2}$ m/s.

$= \left(\dfrac{15}{2} \times \dfrac{18}{5}\right)$ Km/h = 27 Km/h.

**11. (a)** Here, $s_1 = 30$ and $s_2 = 20$.

∴ Average speed $= \dfrac{2s_1s_2}{s_1 + s_2}$

$= \dfrac{2 \times 30 \times 20}{30 + 20} = 25$ Km/h.

**12. (b)** Here, $s_1 = 16$ and $s_2 = 9$.

∴ Average speed $= \dfrac{2s_1s_2}{s_1 + s_2} = \dfrac{2 \times 16 \times 9}{16 + 9} = 11.52$ Km/h.

**13. (c)** Let, the speed on the return journey be $x$ Km/h.

Then, $56 = \dfrac{2s_1s_1}{s_1 + s_2} = \dfrac{2 \times 64 \times x}{64 + x}$

⇒ $7(64 + x) = 16x$ or, $9x = 448$

∴ $x = \dfrac{448}{9} = 49.78$ Km/h.

**14. (b)** Here, $s_1 = 10$ and, $s_2 = 8$.

∴ Average speed $= \dfrac{2s_1s_2}{s_1 + s_2} = \dfrac{2 \times 10 \times 8}{10 + 8} = \dfrac{80}{9}$ Km/h.

Total time taken for the entire journey $= \dfrac{9}{2}$ hours.

∴ Total distance covered
= Average speed × total time taken

$= \dfrac{80}{9} \times \dfrac{9}{2} = 40$ Km.

**15. (c)** Here, $s_1 = 64$ and $s_2 = 80$.

∴ Average speed $= \dfrac{2s_1s_2}{s_1 + s_2} = \dfrac{2 \times 64 \times 80}{64 + 80}$
= 71.11 Km/h.

**16. (b)** Here, $s_1 = 50$, $s_2 = 70$ and $T = 6$.

∴ The length of the journey is

$= T\left(\dfrac{s_1s_2}{s_1 + s_2}\right) = 6\left(\dfrac{50 \times 70}{50 + 70}\right) = 175$ Km.

**17. (a)** $\dfrac{\text{Rakesh's speed}}{\text{Suresh's speed}} = \dfrac{\sqrt{T_2}}{\sqrt{T_1}} = \dfrac{\sqrt{16}}{\sqrt{9}} = \dfrac{4}{3}$.

∴ Suresh's speed $= \dfrac{3}{4}$ Rakesh's speed

$= \dfrac{3}{4} \times 16 = 12$ Km/h.

**18.** **(c)** Here, $x_1 = 225$, $x_2 = 370$, $T_1 = 3 \cdot 5$ and $T_2 = 5$.

$\therefore$ Average speed of train $= \dfrac{x_1 + x_2}{T_1 + T_2} = \dfrac{225+370}{3\cdot5+5}$

$= 70$ Km/h.

**19.** **(b)** Here, $x_1 = 6$, $x_2 = 8$, $x_3 = 32$, $s_1 = \dfrac{3}{2}$,

$s_2 = 2$ and $s_3 = 8$.

$\therefore$ Average speed of the man

$$= \frac{x_1 + x_2 + x_3}{\dfrac{x_1}{s_1} + \dfrac{x_2}{s_2} + \dfrac{x_3}{s_3}} = \frac{6+8+32}{\dfrac{6}{3/2} + \dfrac{8}{2} + \dfrac{32}{8}}$$

$$= \frac{46}{12} = 3\frac{5}{6} \text{ Km/h.}$$

**20.** **(a)** Here, $T_1 = \dfrac{30}{60}$, $T_2 = \dfrac{45}{60}$,

$T_3 = 2$, $s_1 = 40$,

$s_2 = 60$ and $s_3 = 70$.

$\therefore$ The average speed of the car

$$= \frac{s_1T_1 + s_2T_2 + s_3T_3}{T_1 + T_2 + T_3}$$

$$= \frac{40 \times \dfrac{30}{60} + 60 \times \dfrac{45}{60} + 70 \times 2}{\dfrac{30}{60} + \dfrac{45}{60} + 2}$$

$= 63$ Km/h.

**21.** **(b)** Here, change in time $= 20$ and $\dfrac{a}{b} = \dfrac{3}{4}$.

We have, change in time $= \left(\dfrac{b}{a} - 1\right) \times$ original time

$\Rightarrow$ Original time $= \dfrac{\text{Change in time}}{\left(\dfrac{b}{a} - 1\right)}$

$$= \frac{20}{\left(\dfrac{4}{3} - 1\right)} = 60 \text{ minutes.}$$

**22.** **(a)** Here, difference in speeds $= 4 - 3 = 1$

difference in time $= \dfrac{1}{2}$

and, product of speed $= 4 \times 3 = 12$.

We have,

$$\frac{\text{Product of speed}}{d} = \frac{\text{Difference of speed}}{\text{Difference of time}}$$

$\Rightarrow$ $d =$ Product of speed $\times \left(\dfrac{\text{Difference of time}}{\text{Difference of speed}}\right)$

$= 12 \times \dfrac{1/2}{1} = 6$ Km.

**23.** **(c)** Here, difference in speed $= 30 - 20 = 10$.

difference in time $= 2 + 1\dfrac{1}{2} = 4$

and, product of speed $= 20 \times 30 = 600$.

We have, $\dfrac{\text{Product of speed}}{d} = \dfrac{\text{Difference of speed}}{\text{Difference of time}}$

$\Rightarrow$ $d =$ Product of speed $\times \left(\dfrac{\text{Difference of time}}{\text{Difference of speed}}\right)$

$= 600 \times \dfrac{4}{10} = 240$ Km.

**24.** **(a)** Mohan's speed in the first case $= \dfrac{7}{2}$ Km/h.

Mohan's average speed in the second case

$$= \frac{2s_1s_2}{s_1 + s_2} = \frac{2 \times 3 \times 4}{3+4} = \frac{24}{7} \text{ Km/h.}$$

$\therefore$ Difference of speed $= \dfrac{7}{2} - \dfrac{24}{7} = \dfrac{1}{14}$,

Product of speed $= \dfrac{7}{2} \times \dfrac{24}{7} = 12$

and, difference of time $= \dfrac{10}{60}$.

We have,

$d =$ product of speed $\times \left(\dfrac{\text{Difference of time}}{\text{Difference of speed}}\right)$

$= 12 \times \dfrac{10/60}{1/14} = 28$ Km.

**25.** **(b)** Let, the slower speed $= s$ Km/h.

Since the distance travelled is same in both the cases, therefore:

$\dfrac{s_1}{T_2} = \dfrac{s_2}{T_1}$ $\Rightarrow$ $s_1 \times T_1 = s_2 \times T_2$

$\Rightarrow$ $s \times 8 = (s + 5) \times \dfrac{20}{3}$

$\Rightarrow$ $24\ s = 20(s + 5)$

$\Rightarrow$ $s = 25$ Km/h.

**26.** **(c)** Here, $s_1 = 42$ and $s_2 = 28$.

$\therefore$ Stoppage time/h $= \dfrac{s_1 - s_2}{s_1} = \dfrac{42 - 28}{42}$

$= \dfrac{1}{3}$ hour $= 20$ minutes

**27.** **(b)** We have, speed of the train

$$= \frac{\text{Length of the train + length of the platform}}{\text{Total time taken in crossing the platform}}$$

$\Rightarrow$ $60 \times \dfrac{5}{18} = \dfrac{\text{Length of the train} + 130}{15}$

$\Rightarrow$ Length of the train $= 250 - 130 = 120$ m.

**28.** **(a)** Speed of the train

$= \dfrac{\text{Length of the train}}{\text{Time taken in crossing the post}}$

$\Rightarrow$ Length of the train = Speed of the train × Time taken in crossing the post

$= \left(54 \times \dfrac{5}{18}\right) \times 9 = 135$ m.

**29.** **(b)** Time taken in crossing the telegraph post

$= \dfrac{\text{Length of the train}}{\text{Speed of the train}}$

$= \dfrac{135}{54 \times \dfrac{5}{18}} = \dfrac{135 \times 18}{54 \times 5} = 9$ seconds.

**30.** **(c)** Speed of the train

$= \dfrac{\text{Length of the train}}{\text{Time taken in crossing the man}}$

$= \dfrac{160}{18}$ or, $\dfrac{80}{9}$ m/s $= \left(\dfrac{80}{9} \times \dfrac{18}{5}\right)$ Km/h

= 32 Km/h.

**31.** **(a)** Time taken in crossing the platform

$= \dfrac{\text{Length of the train + Length of the platform}}{\text{Speed of the train}}$

$= \dfrac{280+220}{60 \times \dfrac{5}{18}} = \dfrac{500 \times 18}{60 \times 5} = 30$ seconds.

**32.** **(b)** We have,

Speed of the train

$= \dfrac{\text{Length of the train + Length of the platform}}{\text{Time taken in crossing the platform}}$

$= \dfrac{50+100}{10} = 15$ seconds.

**33.** **(b)** Here, $L_1 = 300$ m, $L_2 = 200$ m,

$s_1 = 90$ Km/h and $s_2 = 60$ Km/h

$\therefore\ s_1 - s_2 = 90 - 60 = 30$ Km/h $= 30 \times \dfrac{5}{18}$ m/s

$\therefore$ Time taken $= \dfrac{L_1 + L_2}{s_1 - s_2} = \dfrac{300+200}{30 \times \dfrac{5}{18}}$

$= \dfrac{500 \times 18}{30 \times 5} = 60$ seconds.

**34.** **(c)** Let, the speed of each train be $x$ m/s.

We have, $L_1 = L_2 = 135$ m and $s_1 = s_2 = x$ m/s

Therefore, time taken $= \dfrac{L_1 + L_2}{s_1 + s_2}$

$\Rightarrow\ 18 = \dfrac{135+135}{x+x}$ or, $x = \dfrac{270}{2 \times 18}$ m/s

$= \dfrac{270}{2 \times 18} \times \dfrac{18}{5}$ Km/h = 27 Km/h.

**35.** **(c)** Here, $L_1 = 150$ m, $L_2 = 0$, $s_1 = 95$ Km/h and $s_2 =$ 5 Km/h.

$\therefore\ s_1 - s_2 = 90$ Km/h $= 90 \times \dfrac{5}{18}$ m/s = 25 m/s.

$\therefore$ Time taken $= \dfrac{L_1 + L_2}{s_1 - s_2} = \dfrac{150}{25} = 6$ seconds.

**36.** **(b)** Here, $L_1 = 100$ m, $L_2 = 0$ and $s_2 = 6$ Km/h.

Let, $s_1 = x$ Km/h.

Then, $s_1 + s_2 = (x + 6)$ Km/h $= (x + 6)\ \dfrac{5}{18}$ m/sec.

$\therefore$ Time taken $= \dfrac{L_1 + L_2}{s_1 + s_2}$

$\Rightarrow\ \dfrac{18}{5} = \dfrac{100}{(x+6)\dfrac{5}{18}}$

$\therefore\ x = 100 - 6 = 94$ Km/h.

**37.** **(c)** Relative speed = (50 − 30) Km/h = 20 Km/h

$= \left(20 \times \dfrac{5}{18}\right) = \left(\dfrac{50}{9}\right)$ m/s.

Distance covered in 18 sec at this speed

$= \left(18 \times \dfrac{50}{9}\right)$ m = 100 m.

$\therefore$ Length of the faster train = 100 m.

**38.** **(a)** Speed of the faster train

$= \left(\dfrac{L_1 + L_2}{2}\right)\left(\dfrac{T_1 + T_2}{T_1 T_2}\right) = \left(\dfrac{130+110}{2}\right)\left(\dfrac{60+3}{60 \times 3}\right)$

= 42 m/s.

Speed of the slower train

$= \left(\dfrac{L_1 + L_2}{2}\right)\left(\dfrac{T_1 - T_2}{T_1 T_2}\right) = \left(\dfrac{130+110}{2}\right)\left(\dfrac{60-3}{60 \times 3}\right)$

= 38 m/s.

**39.** **(c)** Speed of the faster train

$= L\left(\dfrac{T_1 + T_2}{T_1 T_2}\right) = 90\left(\dfrac{18+9}{18 \times 9}\right)$

$= \dfrac{90 \times 27}{18 \times 9} = 15$ m/s.

Speed of the slower train

$= L\left(\dfrac{T_1 - T_2}{T_1 T_2}\right) = 90\left(\dfrac{18-9}{18 \times 9}\right)$

$= \dfrac{90 \times 9}{18 \times 9} = 5$ m/s.

**40.** **(a)** Time from 5 am to 6.30 am $= 1\dfrac{1}{2}$ hours.

Therefore, distance of meeting from station

$= \left(\dfrac{s_1 \times s_2 \times T}{s_2 - s_1}\right)$ Km

$= \left(\dfrac{60 \times 75 \times \dfrac{3}{2}}{75 - 60}\right)$ Km = 450 Km

Also, time of their meeting

$$= \left(\frac{s_1 T}{s_2 - s_1}\right) \text{hours}$$

$$= \left(\frac{60 \times \frac{3}{2}}{75 - 60}\right) \text{hours}$$

= 6 hours after 6.30 am

That is, 12.30 pm

**41.** **(c)** Time from 7 am to 8 am = 1 hour.

Therefore, time of their meeting

$$= \left(\frac{d + s_1 T}{s_1 + s_2}\right) \text{hours}$$

$$= \left(\frac{100 + 25 \times 1}{20 + 25}\right) \text{hours}$$

= 3 hours after 7 am.

i.e., 10 am.

**42.** **(a)** Time from 9 am to 11 am = 2 hours.

Therefore, distance of meting point from station A

$$= s_1 \left(\frac{d + s_2 T}{s_1 + s_2}\right) \text{ Km}$$

$$= 50 \left(\frac{210 + 60 \times 2}{50 + 60}\right) \text{ Km} = 150 \text{ Km.}$$

**43.** **(b)** Distance between Mumbai and Pune

$$= d \left(\frac{s_1 + s_2}{s_1 - s_2}\right) \text{ Km}$$

$$= 20 \left(\frac{60 + 40}{60 - 40}\right) \text{ Km} = 100 \text{ Km.}$$

**44.** **(b)** Total time taken $= \left(\frac{3}{10} + \frac{3}{20} + \frac{3}{30} + \frac{3}{60}\right)$ hours

$$= \frac{3}{5} \text{ hours}$$

$\therefore$ Average speed $= \left\{\frac{12}{3/5}\right\}$ Km/h $= \frac{12 \times 5}{3}$ Km/h

= 20 Km/h.

**45.** **(d)** Let, the distance between $P$ to $R = x$ Km

$P \longleftarrow x \longrightarrow R \longleftarrow 21 - x \longrightarrow Q$

Then, $= \frac{21}{4} + \frac{21 - x}{4}$

$\therefore \quad 7x = 2 \times 3 \times 21$

$\therefore \quad x = 18.$

**46.** **(a)** Let, the speeds of the boy and the car by $x$ Km/h and $y$ Km/h, respectively.

Then, $\frac{12/1000}{x} = \frac{36/1000}{y}$

$\therefore \quad \frac{x}{y} = \frac{1}{3}.$

**47.** **(b)** Let, the required speed be $x$ Km/h.

Then, $\frac{2 \times 64 \times x}{64 + x} = 56$

$\Rightarrow \quad 128x = 64 \times 56 + 56x$

$\therefore \quad x = \frac{64 \times 56}{72} = 49.77$ Km/h.

**48.** **(b)** Due to stoppages, it covers 9 Km less per hour.

Time taken to cover 9 Km $= \frac{64 \times 56}{72}$ minutes

= 10 minutes.

So, the bus stops for 10 min. per hour.

**49.** **(a)** Let, the boys meet after first has written $x$ lines

Then 2nd has written $817 - (x + 1) = 816 - x$ lines

Then, $\frac{x}{200} = \frac{816 - x}{150}$

$\therefore \quad x = 466.28$

$\therefore$ Two boys will meet on 467th line.

**50.** **(a)** Distance travelled in 2 minutes

$= \left(1 + \frac{1}{2}\right)$ Km i.e., $\frac{3}{2}$ Kms.

Distance covered in 1 h $= \left(\frac{3}{2} \times \frac{60}{2}\right)$ Km = 45 Km.

$\therefore$ Speed of the train = 45 Km/h.

**53.** **(a)** Let, $x$ Km/h be the speed of the train

$\Rightarrow \quad (x - 6) \times \frac{5}{18} \times 5 = 100$

$\Rightarrow \quad x = 78$ Km/h.

Let, the speed of the car be $y$ Km/h.

$\Rightarrow \quad (78 - y) \times \frac{5}{18} \times 6 = 100 \quad \Rightarrow \quad y = 18.$

**54.** **(a)** Speed of the first man = 32 Km/h.

Time taken = 192 ÷ 32 = 6 hours.

Second man covers 192 Km in 3 hours.

$\therefore$ Speed of the second man = 192 ÷ 3

= 64 Km/h

Ratio = 32:64, or 1:2,

**55.** **(c)** Let, the length of another train = $x$ m

Their relative speed = (62 + 40) Km/h

$$= \left(102 \times \frac{5}{18}\right) \text{m/s} = \frac{85}{3} \text{ m/s}$$

$$\frac{250 + x}{\frac{85}{3}} = 18 \quad \Rightarrow \quad \frac{3(250 + x)}{85} = 18$$

$\Rightarrow \quad 250 + x = 510$

$\Rightarrow \quad x = 260$

$\therefore$ Length of another train = 260 m.

**56.** **(b)** Let, the length of the train be $x$ metres and its speed by $y$ metres/sec.

Then, $\frac{x}{y} = 15 \Rightarrow y = \frac{x}{15}$

Now, $\frac{x+100}{25} = \frac{x}{15} \Rightarrow x = 150$ m.

**57.** **(b)** Relative speed $= \left(\frac{150+100}{10}\right)$ m/s.

$= 25$ m/s.

$= \left(25\times\frac{18}{5}\right)$ Km/h

$= 90$ Km/h

$\therefore$ Speed of second train $= (90 - 30)$ Km/h

$= 60$ Km/h.

**58.** **(c)** Distance already covered $= \frac{2}{3}\times 45 = 9$ Km

Time spent $= \frac{2}{3}\times 45$ minutes $= 30$ minutes.

Distance left $= (12 - 9)$ Km

$= 3$ Km

Time left $= (45 - 30)$ minutes $= 15$ minutes

$\therefore$ Required speed $= \frac{3}{15/60}$ Km/h $= 12$ Km/h.

**59.** **(a)** Let, the speed of the train in Km/h $= x$.

Then, relative speed $= (x + 6)$ Km/h

$= (x + 6) \times \frac{5}{18}$ m/s.

$\therefore$ $(x + 6) \times \frac{5}{18} \times 6 = 110$

$\therefore$ $x = 60$

$\therefore$ Speed of the train $= 60$ Km/h.

**60.** **(d)** Let, the speed of the train $= x$ Km/h.

Relative speed $= (x + 6)$ Km/h

$= (x + 6) \times \frac{5}{18}$ m/s.

$\therefore$ $(x + 6) \times \frac{5}{18} \times 6 = 110$

$\therefore$ $x = 60$

$\therefore$ Speed of train $= 60$ Km/h for the person,

Relative speed $= (60 - 6)$ Km/h

$= 54 \times \frac{5}{18}$ m/s $= 15$ m/s.

$\therefore$ Time taken to cross the second person

$= \frac{110}{15} = \frac{22}{3} = 7\frac{1}{3}$ seconds.

**61.** **(d)** Let, the total journey be $x$ Km. Then,

$\frac{2}{15}x + \frac{9}{20}x + 10 = x$

$\Rightarrow$ $8x + 27x + 600 = 60x$

$\Rightarrow$ $x = 24$

$\therefore$ Total journey $= 24$ Km.

## Exercise-2
## (Based on Memory)

**1.** **(a)** Let, the distance covered by him each way be $x$ Km

$\frac{x}{45} - \frac{x}{50} = 1, \frac{10x - 9x}{450} = 1$ ; $x = 450$ Km.

**2.** **(d)** Total times taken $= \frac{24}{8} + \frac{18}{9} + \frac{2}{3} = 9$ hours.

$\therefore$ Average speed $= \frac{\text{Total distance}}{\text{Total time}}$

$= \frac{24 + 18 + 12}{9} = 6$ Km/h.

**3.** **(d)** Total time required $= \frac{14}{5} + \frac{14}{10} = \frac{28 + 14}{10} = 4.2$ hours.

**4.** **(c)** Required average speed

$= \frac{(35 + 69)}{\frac{(45 + 75)}{60}} = \frac{104 \times 60}{120} = 52$ Km/h.

**5.** **(d)** Required distance $= 2000\left(\frac{15}{40}\right) = 750$ m

**6.** **(e)** The required speed $= \frac{180 + 180}{18} = 20$ m/s

**7.** **(e)** Average speed

$= \frac{\text{Total distance travelled}}{\text{Time taken to travel the distance}}$

$= \frac{(30+25)}{\frac{(45+35)}{60}} = \frac{55\times 60}{80} = 41\frac{1}{4}$ Km/h.

**8.** **(c)** Let, the length of the train be $x$ metres.

$\therefore$ The distance of $(x + 800)$ metres is covered in 100 seconds.

The distance of $(x + 400)$ metres iscovered in 60 seconds.

$\therefore$ $\frac{x + 800}{100} = \frac{x + 400}{600}$

$\Rightarrow$ $3(x + 800) = 5(x + 400)$

$\Rightarrow$ $2x = 400 \Rightarrow x = 200$

**9. (c)** Let, the normal speed of the train be $x$ Km/h. Let, the distance of $k$ Km be covered by the train in 22 hours running at the speed of $\frac{7}{11}x$ Km/h.

$\therefore \quad 22 \times \frac{7}{11}x = k \Rightarrow k = 14x$

$\Rightarrow$ The train would have taken 14 hours if it would have run at its normal speed.

**10. (c)** In 30 seconds, the train covers a distance of $150 + 500 = 650$ m.

$\therefore$ To cross a platform 370 m long, the train will have to cover a distance of $370 + 150 = 520$ m.

Now the distance of 650 m is covered by the train in 30 seconds.

$\therefore$ The distance of 520 metres is covered by the train in $\frac{30}{650} \times 520 = 24$ seconds.

**11. (d)** Distance covered in one hour = 60 Km.

$\Rightarrow$ Distance covered in 3600 seconds = 60000 m

$\Rightarrow$ Distance covered in 30 seconds

$= \frac{60000}{3600} \times 30 = 500$ m.

**12. (d)** Distance to be covered by the train

$= 120 + 230 = 350$ m

Distance of 90 Km is covered by the train in one hour

i.e., Distance of 90000 m is covered by the train in 3600 seconds

i.e., Distance of 350 m is covered by the train in

$\frac{3600 \times 350}{90000} = \frac{36 \times 35}{90} = 14$ seconds

**13. (d)** 180 Km/h

$\Rightarrow$ 180000 m/360 seconds $\Rightarrow$ 50 m/s

**14. (d)** Speed in Km/h $= \frac{10 \times 18}{5} = 36$ Km/h.

**15. (d)** $30 \times S - 30 \times \frac{14}{15} S = 10$

or, $30\left(\frac{1}{15}S\right) = 10$ or, $S = \frac{10 \times 15}{30} = 5$

Hence, required speed = 5 Km/h.

**16. (a)** Speed of train $= \frac{120}{10} = 12$ m/s.

**17. (b)** Speed of train $= \frac{264}{20 - 8} = 22$ m/s.

Hence, length of train $= 22 \times 8 = 176$ m.

**18. (d)** Speed of the train = 180 Km/h

= 180000 m/3600 sec.

= 50 m/s.

**19. (b)** Let, the actual speed of the car be $x$ Km/h.

If the speed of the car is $\frac{5}{7}x$ Km/h, then running at this speed, the distance of 42 Km is covered in 1 hour 40 minutes 48 seconds, i.e., 1 hour $40\frac{4}{5}$ minutes, i.e., $\frac{126}{75}$ hours

$\therefore \quad 42 \times \frac{75}{126}$ Km/h, that is, 25 Km/h $= \frac{5x}{7}$

$\therefore \quad 25 = \frac{5x}{7} \quad \Rightarrow \quad x = 35$ Km/h.

**20. (d)** Speed of the train = 120 m/6 sec

= 7200 m/360 sec.

= 72000 m/3600 sec

= 72 Km/h.

**21. (b)** Let, the length of the train be $x$ metres. It passes a telegraph post in 8 seconds.

$\because$ A distance of $(x + 264)$ metres is covered by the $x$ metres long train in 20 seconds

$\therefore \quad \frac{x}{8} = \frac{x+264}{20} \quad \Rightarrow \quad x = 176$ m.

**22. (b)** $78 \times \frac{5}{18} = \frac{\text{Length of (train + tunnel)}}{60}$

or, $78 \times \frac{5}{18} \times 60 = 800 + x$

or, $1300 - 800 = x$ or, $x = 500$ m.

**24. (b)** Required time $= \frac{160+140}{(77+67)\times\frac{5}{18}} = \frac{300\times18}{144\times5}$

= 7.5 seconds.

**25. (c)** Suppose, the speed of the train is $V$ m/s

Then, $V + V = \frac{120+120}{12} = 20$

or, $2V = 20 \times \frac{18}{5} = 72$

or, $V = 36$ Km/h.

**26. (a)** Required time $= \frac{100}{144\times\frac{5}{18}} = \frac{100}{40} = 2.5$ seconds.

**27. (a)** For same distance, we have

$V_1 t_1 = V_2 t_2$

or, $t_2 = \frac{V_1 t_1}{V_2} = \frac{40 \times 9}{60} = 6$ hours.

**28. (c)** Length of the train $= 120 \times \frac{5}{18} \times 15$

= 500 m.

**29.** **(e)** Distance travelled by the car = 80 × 10

= 800 Km.

$\therefore$ Speed = $\frac{800}{8}$ = 100 Km/h

$\therefore$ Speed gain = 100 − 80 = 20 Km/h.

**30.** **(b)** Distance covered by train A before the train B leaves Mumbai Central = 60 × 3 = 180 Km.

$\therefore$ Time taken to cross each other

$=\frac{180}{12}$ = 15 hours

$\therefore$ Required time = 2 pm + 15 hours

= 5 am on the next day.

**32.** **(e)** This is the problem of arithmetic progression with the first term $a$ = 35, common difference $d$ = 2, and total number of terms ($n$) = 12. The sum of this series will be the total distance travelled.

$$\text{Sum } S_n = \frac{n}{2}[2a+(n-1)d] = \frac{12}{2}[70+11\times 2]$$

$$= \frac{12\times 92}{2} = 552 \text{ Km.}$$

**33.** **(c)** $m$ miles in $h-\frac{1}{2}=\frac{2h-1}{2}$ hours

$\Rightarrow$ $\frac{2m}{2h-1}$ miles per hour.

**34.** **(d)** Let, the speed of the train be $x$ Km/h

Relative speed = $x$ − 3 Km/h

Distance covered in 33 s = 300 m

$$\frac{300\times 3600}{33\times 1000} = x-3$$

$$\Rightarrow \quad \frac{360}{11} = x-3$$

$$\Rightarrow \quad x = 32\frac{8}{11}+3 = 35\frac{8}{11} \text{ Km/h}$$

**35.** **(c)** Let, the speed of the man be $x$ Km/h

Relative speed = 20 + $x$

$\Rightarrow$ Distance covered at (20 + $x$) Km/h in 8 minutes.

= Distance covered at 20 Km/h in 10 minutes.

Solving we get $x$ = 5 Km/h

**36.** **(b)** Let, the speed of the second train be $x$ Km/h.

$\therefore$ Relative speed = ($x$ + 60) Km/h

and the total distance

$$= \frac{180+270}{1000} \text{ Km} = \frac{450}{1000} \text{ Km}$$

$$\because \quad \frac{450}{1000} = (x+60)\times\frac{10.8}{60\times 60}$$

$$\Rightarrow \quad (x+60) = \frac{450\times 60\times 60}{10.8\times 1000} = 150$$

$$\therefore \quad x = 150-60$$

$$= 90 \text{ Km/h.}$$

**37.** **(b)** Let, both the trains will meet at $x$ Km far away from Delhi.

Then, as per the question:

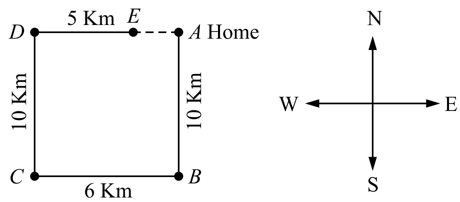
$$\frac{x}{60} = \frac{x}{80}+2$$

$$\Rightarrow \quad 80x - 60x = 2\times 80\times 60$$

$$\Rightarrow \quad 20x = 2\times 80\times 60$$

$$\therefore \quad x = 480 \text{ Km.}$$

**38.** **(c)**




$\therefore$ $AE$ = 1 Km

**39.** **(c)** Distance travelled by Car $A$ = 65 × 8 = 520 Km.

Distance travelled by Car $B$ = 70 × 4 = 280 Km.

$$\text{Ratio} = \frac{520}{280} = 13{:}7$$

**40.** **(a)** Distance = 30 × 6 = 180 Km

Speed of Hema = $\frac{180}{4}$ = 45 Km/h

Speed of Deepa, after increasing average speed

$= \frac{180}{30+10} = 4\frac{1}{2}$ h = 4 hours 30 minutes

Speed of Hema, after increasing average speed

$= \frac{180}{45+5} = 3\frac{3}{5}$ h = 3 hours 36 minutes

Difference = 4 hours 30 minutes − 3 hours 36 minutes = 54 minutes

**41.** **(a)** Speed of bus = $\frac{480}{8}$ = 60 Km/h

Speed of train = $\frac{60\times 4}{3}$ = 80 Km/h

Speed of train:Speed of car = 16:15

$\therefore$ Speed of car = $\frac{80}{16}$ × 15 = 75 Km/h

Distance covered by car in 6 hours = 75 × 6 = 450 Km

**42.** **(d)** Speed of the train = 120 Km/h

$= 120\times\frac{5}{18}$ m/s

$= \frac{100}{3}$ m/s

Suppose, the length of the platform = $x$ m.

Then,

$$\frac{x+320}{\frac{100}{3}} = 24$$

$\Rightarrow \quad 3(x + 320) = 100 \times 24$

$\Rightarrow \quad x + 320 = 800$

$\Rightarrow \quad x = 800 - 320 = 480$ m

Hence, speed of a man

$= \frac{480}{4\times 60}$ m/s = 2 m/s

**43. (c)** Average speed of a tractor

$$= \frac{575}{23} = 25 \text{ Km/h}$$

The speed of a bus in an hour = 25 × 2 = 50 Km

The speed of a car in an hour = $50 \times \frac{9}{5}$ = 90 Km

So, the distance covered by car in 4 hours is

90 × 4 = 360 Km

**44. (a)** Let, the length of Train B = $x$ m.

Then the length of Train A = $\frac{x}{2}$ m

Speed of Train A = $\frac{\frac{x}{2}}{25} = \frac{x}{50}$

Speed of Train B = $\frac{x}{75}$

Ratio of speed = $\frac{A}{B} = \frac{\frac{x}{50}}{\frac{x}{75}} = \frac{75}{50}$ = 3:2.

**45. (d)** Suppose, the speed of the train = $x$ m/s

$\frac{240}{x} + 40 = \frac{240+480}{x}$

$240 + 40x = 720$

$40x = 720 - 240$

$40x = 480$

$x = \frac{480}{40}$ = 12 m/s

or, Distance = 2 × 240 m = 480 m

Time = 40 s

Speed = $\frac{480}{40}$ = 12 m/s

**46. (a)** Speed of the train = $\frac{200+400}{36} = \frac{600}{36}$

$= \frac{50}{3}$ m/s $= \frac{50}{3} \times \frac{18}{5}$ = 60 Km/h.

**47. (b)** From point $A$ to $B$, speed = 4 Km/h.

From point $B$ to $A$, speed = 6 Km/h.

Ratio of required time = 4:6 = 2:3.

**48. (a)** Distance between Ramgarh and Devgarh

$$= \frac{50\times 44}{60} = \frac{110}{3}$$

If average speed of the bus is increased by 5 Km/h, then the speed of the bus = 55 Km/h

Required time = $\frac{\text{Distance}}{\text{Speed}}$

$= \frac{110}{3} \times \frac{60}{55}$ = 40 min

**49. (a)** Bus fare = ₹420

Train fare = $420 \times 2 \times \frac{3}{4}$ = ₹630

Total fare = 2 × 420 + 4 × 630

= 840 + 2520 = ₹3360

**50. (a)** If the length of train B is $x$ m, then speed of train

$\Rightarrow \quad \frac{240+x}{50} = \frac{240}{20}$

$\frac{240+x}{50} = 12$

$240 + x = 600$

$x = 600 - 240$

$x = 360$ m

**51. (b)** Total distance = 64 × 8 = 512 Km

Now, speed = $\frac{512}{6} \approx 85$ Km/h

**52. (a)** Distance covered in 2nd minute = 90 − 50 = 40 metres

Distance covered in 3rd minute =130 − 90 = 40 m

∴ Required distance = 50 + 40 × 14

= 50 + 560 = 610 m

**53. (c)** Required distance = LCM of 63, 70 and 77 cm = 6930 cm

$$\begin{array}{c|c} 7 & 63, 70, 77 \\ \hline & 9, 10, 11 \end{array}$$

∴ $\text{LCM} = 7\times 9\times 10\times 11 = 6930$

**54. (a)** Let the journey on foot be $x$ Km.

∴ Journey on cycle = $(80 - x)$ Km

Now, according to the question,

$\frac{x}{8} + \frac{80-x}{16} = 7$

$\Rightarrow \quad \frac{2x+80-x}{16} = 7$

$\Rightarrow \quad x + 80 = 16\times 7 = 112$

$\Rightarrow \quad x = 112 - 80 = 32$ Km

**55.** **(a)** Let, the length of each train be $x$ metres.

Relative speed = (46 − 36) = 10 Km/h

$$= \left(10\frac{5}{10}\right) \text{m/sec} = \frac{25}{9} \text{ m/sec}$$

∴ Time taken in crossing each other

$$= \frac{\text{Length of both trains}}{\text{Relative speed}}$$

$$\Rightarrow \quad 36 = \frac{2x}{\frac{25}{9}}$$

$$\Rightarrow \quad 2x = 36 \times \frac{25}{9} = 100$$

$$\Rightarrow \quad x = \frac{100}{2} = 50 \text{ metres}$$

**56.** **(d)** Distance covered by the car in 2 hours

$$= \frac{300 \times 40}{100} = 120 \text{ Km}$$

Remaining distance = (300 − 120) = 180 Km

Remaining time = (4 − 2) = 2 hours

$$\therefore \quad \text{Required speed} = \left(\frac{180}{2}\right) = 90 \text{ Km/h}$$

$$\text{Original speed of car} = \left(\frac{120}{2}\right) = 60 \text{ Km/h}$$

∴ Required increase in speed = 90 − 60 = 30 Km/h

**57.** **(a)** Speed of the train = 54 Km/h

$$= \left(\frac{54 \times 5}{18}\right) \text{m/sec} = 15 \text{ m/sec}$$

$$\text{Required time} = \frac{\text{Length of trains}}{\text{Speed of train}}$$

$$= \left(\frac{300}{15}\right) = 20 \text{ seconds}$$

**58.** **(b)** Time taken in covering 5 Km

$$= \frac{5}{10} = \frac{1}{2} \text{ hour} = 30 \text{ minutes}$$

That person will take rest for four times.

∴ Required time = (30 + 4 × 5) minutes = 50 minutes

**59.** **(d)** **Quicker Method:**

Required average speed

$$= \frac{2 \times 30 \times 20}{30 + 20} = \frac{2 \times 30 \times 20}{50} = 24 \text{ Km/h}$$

**60.** **(a)** Let, the speed of cyclist be $x$ Km/h and time be $t$ hours.

$$\therefore \quad \text{Required ratio} = \frac{xt}{2 \times 2t} : x = 1:4$$

**61.** **(a)** Time taken in covering 999 Km

$$= \frac{999}{55.5} = 18 \text{ hrs}$$

∴ Required time = 18 hours + 1 hour 20 minutes = 19 hours 20 minutes, i.e., 1:20 am

**62.** **(b)** Let, the distance of the school be $x$ Km.

Now, according to the question,

$$\frac{x}{3} - \frac{x}{4} = \frac{20}{60}$$

$$\Rightarrow \quad \frac{x}{12} = \frac{1}{3} \quad \Leftrightarrow \quad x = \frac{12}{3} = 4 \text{ Km}$$

**63.** **(c)** Relative speed = (40 − 20) = 20 Km/h

$$= \frac{20 \times 5}{18} \text{ m/s.}$$

$$\therefore \text{Length of the faster train} = \frac{20 \times 5}{18} \times 5 \text{ m} = \left(\frac{250}{9}\right) = 27\frac{7}{9} \text{ m}$$

**64.** **(c)** Distance covered by cycling in $3\frac{1}{4}$ hours

= Distance covered by scooter in $2\frac{1}{4}$ hours

$$\Rightarrow \quad 12 \times \frac{7}{2} = x \times \frac{9}{4}$$

$$\Rightarrow \quad x = \frac{12 \times 7 \times 2}{9} = \frac{56}{3} = 18\frac{2}{3} \text{ Km/h}$$

**65.** **(a)** $40 \text{ km/h} = \frac{40}{60} \text{Km/minute} = \frac{2}{3} \text{Km/minute}$

$$50 \text{ km/h} = \frac{50}{60} = \frac{5}{6} \text{ Km/minute}$$

Let, distance be $x$ Km and the actual time be $t$ minutes, Then, according to the question,

$$\frac{x}{\frac{2}{3}} = t + 11 \qquad \cdots(1)$$

$$\frac{x}{\frac{5}{6}} = t + 5 \qquad \cdots(2)$$

By equations (1) and (2), we have

$$\frac{3x}{2} - \frac{6x}{5} = 6$$

$$\Rightarrow \quad \frac{15x - 12x}{10} = 6$$

$$\Rightarrow \quad 3x = 60 \text{ Km}$$

$$\Rightarrow \quad x = 20 \text{ Km}$$

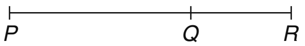
From equation (1),

$$\frac{3x}{2} = t + 11$$

$$\Rightarrow \quad \frac{3 \times 20}{2} = t + 11$$

$$\Rightarrow \quad t = (30 - 11) = 19 \text{ minutes}$$

**66. (b)**




Let the trains meet after $t$ hours.

Now, according to the question,

$24t - 18t = 27$

$$\Rightarrow \quad 6t = 27 \quad \Rightarrow \quad t = \left(\frac{27}{6}\right) = \frac{9}{2} \text{ hours}$$

$$\therefore \quad QR = 18t = \left(18 \times \frac{9}{2}\right) = 81 \text{ Km}$$

**67. (c)** Speed of train A = $x$ Km/h

Speed of train B = $y$ Km/h

$$\therefore \quad \frac{x}{y}\sqrt{\frac{t_2}{t_1}}$$

$$\Rightarrow \quad \frac{45}{y} = \sqrt{\frac{3+\frac{1}{3}}{4+\frac{48}{60}}} = \sqrt{\frac{\frac{10}{3}}{4+\frac{4}{5}}}$$

$$= \sqrt{\frac{10}{3} \times \frac{5}{24}} = \sqrt{\frac{25}{36}} = \frac{5}{6}$$

$$\Rightarrow \quad 5y = 45 \times 6 \quad \Rightarrow \quad y = \frac{45 \times 6}{5}$$

$= 54$ Km/h

**68. (a)** Let, the distance between stations be $x$ Km. Therefore,

$$\text{Speed of train} = \frac{x}{\frac{45}{60}} = \frac{4x}{3} \text{ Km/h}$$

Now, according to the question,

$$\frac{x}{\frac{4x}{3} - 5} = \frac{48}{60}$$

$$\Rightarrow \quad \frac{3x}{4x-15} = \frac{4}{5} \quad \Rightarrow \quad 16x - 60 = 15x$$

$\Rightarrow \quad x = 60$ Km

**69. (d)** Let, the total distance be 1 Km.

$$\therefore \quad \text{Total time} = \frac{1}{5 \times 8} + \frac{1}{10 \times 25} + \left(\frac{1 - \frac{1}{5} - \frac{1}{10}}{20}\right)$$

$$\left[\text{Time} = \frac{\text{Distance}}{\text{Speed}}\right]$$

$$= \frac{1}{40} + \frac{1}{250} + \left(\frac{\frac{10-2-1}{10}}{20}\right)$$

$$= \frac{1}{40} + \frac{1}{250} + \frac{7}{200} = \frac{25+4+35}{1000} = \frac{64}{1000}$$

$$= \frac{8}{125} \text{ hours}$$

$$\therefore \quad \text{Average speed} = \frac{\text{Total distance}}{\text{Time taken}}$$

$$= \frac{125}{8} = 15.625 \text{ Km/h}$$

**70. (b)** Let, the distance of school be $x$ Km.

Then, according to the question,

$$\frac{x}{3} - \frac{x}{4} = \frac{10}{60}$$

$$\Rightarrow \quad \frac{4x-3x}{12} = \frac{1}{6} \quad \Rightarrow \quad \frac{x}{12} = \frac{1}{6}$$

$$\Rightarrow \quad x = 2 \text{ Km.}$$

**71. (b)** Speed and time are inversely proportional for a fixed distance.

$$\therefore \quad \frac{4}{3} \text{ of usual time} - \text{usual time} = 20 \text{ minutes}$$

$$\Rightarrow \quad \text{Usual time} \times \frac{1}{3} = 20$$

$$\therefore \quad \text{Usual time} = (3 \times 20) = 60 \text{ minutes}$$

### Alternative Method:

Let, the original speed be $x$ Km/h and the usual time be $y$ hours.

Now, according to the question,

$$xy = \frac{3}{4}x\left(y + \frac{1}{3}\right)$$

$$\Rightarrow \quad 4y = 3y + 1 \quad \Rightarrow \quad 4y - 3y = 1$$

$$\Rightarrow \quad y = 1 = 60 \text{ minutes}$$

**72. (b)** Let, the required distance be $x$ Km.

Time taken in travelling with the speed of $3 \text{ Km/h} = \frac{x}{3}$ hours

Now, time taken in travelling with the speed of $4 \text{ Km/h} = \frac{x}{4}$ hours

Now according to the question,

$$\frac{x}{3} - 5 = \frac{x}{4} + 5$$

$$\Rightarrow \frac{x}{3} - \frac{x}{4} = 5 + 5 = 10$$

$$\Rightarrow x\left(\frac{1}{3} - \frac{1}{4}\right) = \frac{1}{6} \text{ hours}$$

$$\Rightarrow \frac{x}{12} = \frac{1}{6}$$

$\therefore \quad x = 2$ Km.

**73.** **(a)** Let the speeds of the cars starting from A and B be $x$ Km/h and $y$ Km/h respectively. Now, according to the question,

Case I: When both the cars are running inthe same direction

Relative speed = $(x - y)$ Km/h

$\therefore \quad 5x - 5y = 100 \qquad \cdots(1)$

Case II: When both the cars are running inthe opposite directions

Relative speed = $(x + y)$ Km/h

$\therefore \quad (x + y) \times 1 = 100$

$\Rightarrow \quad x + y = 100 \qquad \cdots(2)$

Now, solving Eqn. (1) and Eqn. (2), we have

$x = 60$ and $y = 40$

Therefore, speed of the faster car is 60 Km/h

**74.** **(c)** Speed of train = 60 Km/h.

$$= 60 \times \frac{5}{18} \text{ m/s} = \frac{50}{3} \text{ m/s}$$

Let the speed of the second train be $x$ m/s.

Since, both trains are going in same direction.

$$\therefore \quad \text{Relative speed} = \left(\frac{50}{3} - x\right) \text{m/s}$$

Now, according to the question,

$$\frac{120}{\left(\frac{50}{3} - x\right)} = 18$$

$$\Rightarrow \frac{50}{3} - x = \frac{20}{3}$$

$$\therefore x = \frac{50}{3} - \frac{20}{3} = 10 \text{ m/s } = 10 \times \frac{18}{5} = 36 \text{ Km/h}$$

**75.** **(a)** Relative speed $= 93 + 51 = 144 \times \frac{5}{18} = 40$ m/s

Total length of the two trains = 40 × 24 = 960 metres

$$\therefore \quad \text{Length of the first train} = 960 \times \frac{2}{3} = 640 \text{ m}$$

Let the length of the bridge be $x$ m.

$$\therefore \quad 640 + x = 93 \times \frac{5}{18} \times 66$$

Solving, we get $x = 1065$

**76.** **(c)** Speed of the man from P to Q = 40 Km/h

$$\text{Speed of the man from Q to P} = \frac{40 \times 150}{100} = 60 \text{ Km/h}$$

$$\therefore \quad \text{Average speed} = \frac{2 \times 40 \times 60}{40 + 60} = 48 \text{ Km/h}$$

**77.** **(c)** Let the fare of first five kilometres be ₹$x$.

Total distance = 187 Km

Remaining distance = 187 − 5 = 182 Km

Now, $x + 182 \times 13 = 2402$

$\therefore \quad x = 2402 - 2366 =$ ₹36

**79.** **(e)** Speed of the car $= \frac{588}{6} = 98$ Km/h

Speed of the train $= \frac{10}{7} \times 98 = 140$ Km/h

Distance covered by the train in 13 hours = 140 × 13 = 1820 Km

**80.** **(d)** Average speed $= \frac{\text{Total distance covered}}{\text{Total time taken}}$

$$= \frac{39 + 25}{\frac{45 + 35}{60}} = \frac{64 \times 60}{80} = 48 \text{ Km/h}$$

**81.** **(b)** Speed of the car $= \frac{\text{Distance covered}}{\text{Time Taken}} = \frac{720}{9}$

= 80 Km/h

Speed of the bus $= \left(\frac{3}{4} \times 80\right) = 60$ Km/h

Speed of the train $= \left(\frac{27}{15} \times 60\right) = 180$ Km/h

Distance covered by the train in 7 hours = (7 × 108) = 756 Km

**82.** **(d)** Total amount spent $= \left(\frac{591}{3} + \frac{45}{60} \times 780\right)$ paisa

= (197 + 585) paisa

= 782 paisa = ₹7.82

**83.** **(b)** Speed of the train = 108 Km/h $= \left(108 \times \frac{5}{18}\right)$ m/s

Let, the length of the platform be $x$ m, then

$$\frac{x + 280}{12} = 30$$

$$\Rightarrow \quad x + 280 = 360$$

$\Rightarrow \quad x = (360 - 280) = 80$ m

$$\therefore \quad \text{The man's speed} = \frac{\text{Distance}}{\text{Time}} = \left(\frac{80}{10}\right) = 8 \text{ m/s}$$

**84.** **(c)** Speed of the tractor $= \frac{\text{Distance}}{\text{Time}} = \frac{575}{23} = 75$ Km/h

$\therefore$ Speed of the bus = 50 Km/h

$$\therefore \text{ Speed of the car} = \frac{9}{5} \times 50 = 90 \text{ Km/h}$$

$\therefore$ Distance covered by the car in 4 hours = 4 × 90 = 360 Km

**85.** **(d)** Average speed $= \frac{\text{total distance}}{\text{total time}}$

$$\text{Total time} = \frac{45}{60} + \frac{35}{60} = \frac{3}{4} \text{ hours and}$$

Total distance = 39 + 25 = 64 Km

$$\therefore \quad \text{Average speed} = \frac{39 + 25}{\frac{4}{3}} = \frac{64}{4} \times 3 = 48 \text{ Km/h}$$

**86.** **(a)** Let the length of the bus = $l$ units, then

Speed of the man $= \frac{l}{18}$ unit/seconds

Speed of the bus $= \frac{l}{4}$ unit/seconds

$\therefore$ Their ratio $= \frac{l}{4} : \frac{l}{18} = 9:2$.

**87.** **(a)** Speed of train $A = \frac{240}{20} = 12$ m/s

In 50 seconds, the train covers 50 × 12 = 600 m

$\therefore$ Length of train B = 600 − 240 = 360 m

**88.** **(a)** Speed of the tractor $= \frac{360}{12} = 30$ Km/h

Speed of the jeep $= \frac{5}{2} \times 30 = 75$ Km/h

Speed of the car $= \frac{3}{2} \times 30 = 45$ Km/h

Required average speed of the car and the jeep

$$= \frac{1}{2}(75 + 45) = \frac{1}{2} \times 120 = 60 \text{ Km/h}$$

**89.** **(c)** Let the speeds of the car, train and bus be $5x$ Km/h, $9x$ Km/h and $4x$ Km/h, respectively.

Their average speed $= \frac{5x + 9x + 4x}{3} = \frac{18x}{3} = 6x$ Km/h

Also, $6x = 72 \Rightarrow x = 12$ Km/h

Average speed of the car and the train together is

$$= \frac{5x + 9x}{2} = 7x = 7 \times 12 = 84 \text{ Km/h}$$

**90.** **(b)** Relative speed of the two trains

$$= \frac{180 + 270}{10.8} \text{ m/s} = \frac{4500}{180} \text{ m/s}$$

$$= \frac{4500}{108} \times \frac{18}{5} \text{ Km/h} = 150 \text{ Km/h}$$

Speed of the second train = 150 − 60 = 90 Km/h

**91.** **(b)** The least time interval after A, B and C can meet will be the LCM of time taken by them separately,

i.e., 360 seconds = 6 minutes.

**92.** **(a)** Distance $= \frac{44}{60} \times 50 = \frac{x}{60} \times 55$

$\therefore$ $x$ = 40 minutes

# Boats and Streams

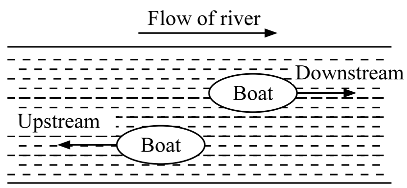
# 13

### Some Important Terms

1. **Still Water:** If the speed of the water in a river is zero, it is called, 'still water'.
2. **Stream:** If the water of a river is moving, it is called, a *stream*'.
3. **Upstream:** If a boat (or a swimmer) moves against a stream, i.e., in the direction is opposite to that of the stream, it is called, '*upstream*'.
4. **Downstream:** If a boat (or a swimmer) moves with a stream, i.e., along the direction of a stream, it is called, '*downstream*'.

***Note:***

When the speed of a boat or a swimmer is given, it usually means speed in the still water.




## SOME BASIC FORMULAE

1. If the speed of a boat (or a swimmer) be $x$ Km/h and the speed of a stream or the current be $y$ Km/h, then:
   (a) the speed of the boat (or swimmer) downstream $= (x + y)$ Km/h.
   (b) the speed of the boat (or swimmer) upstream $= (x - y)$ Km/h.

**Illustration 1:** The speed of a boat in still water is 20 Km/h. If the speed of the stream be 4 Km/h, find out its downstream and upstream speeds.

**Solution:** Speed of the boat ($x$) = 20 Km/h

Speed of the stream ($y$) = 4 Km/h

$\therefore$ Downstream speed $= x + y = (20 + 4) = 24$ Km/h

Upstream speed $= x - y = (20 - 4) = 16$ Km/h.

2. (a) Speed of the boat (or swimmer) in still water

$$= \frac{1}{2}(\text{Downstream Speed} + \text{Upstream Speed})$$

(b) Speed of the stream

$$= \frac{1}{2}(\text{Downstream Speed} - \text{Upstream Speed})$$

**Illustration 2:** A boat is rowed down a river 40 Km in 5 h and up a river 21 Km in 7 h. Find the speed of the boat and the river.

**Solution:** Speed of the boat downstream $= \frac{40}{5} = 8$ Km/h.

Speed of the boat upstream $= \frac{21}{7} = 3$ Km/h.

$\therefore$ Speed of the boat

$$= \frac{1}{2}(\text{Downstream Speed} + \text{Upstream Speed})$$

$$= \frac{1}{2}(8 + 3)$$

$$= \frac{11}{2} \quad \text{or, } 5{\cdot}5 \text{ Km/h.}$$

and, speed of the river

$$= \frac{1}{2}(\text{Downstream Speed} - \text{Upstream Speed})$$

$$= \frac{1}{2}(8 - 3) = \frac{5}{2}$$

or, 2·5 Km/h.

## SOME USEFUL SHORTCUT METHODS

1. If a man capable of rowing at the speed of $x$ Km/h in still water, rows the same distance up and down a stream which flows at a rate of $y$ Km/h, then his average speed throughout the journey is

$$= \frac{\text{Uptream} \times \text{Downstream}}{\text{Man's rate in still water}}$$

$$= \frac{(x-y)(x+y)}{x} \text{ Km/h.}$$

**Illustration 3:** A man rows at a speed of 8 Km/h in still water to a certain distance upstream and back to the starting point in a river which flows at 4 Km/h. Find his average speed for total journey.

**Solution:** Average Speed

$$= \frac{\text{Upstream} \times \text{Downstream}}{\text{Man's rate in still water}}$$

$$= \frac{(8-4)(8+4)}{8} = 6 \text{ Km/h.}$$

2. A man can row a boat in still water at $x$ Km/h. In a stream flowing at $y$ Km/h, if it takes $t$ hours more in upstream than to go downstream for the same distance, then the distance is given by

$$\frac{(x^2-y^2)t}{2y} \text{ Km}$$

**Illustration 4:** A man can row 7 Km/h in still water. If the river is running at 3 Km/h, it takes 6 hours more in upstream than to go downstream for the same distance. How far is the place?

**Solution:** The required distance

$$= \frac{(x^2-y^2)t}{2y}$$

$$= \frac{(49-9)6}{2\times 3} = 40 \text{ Km.}$$

3. A man rows a certain distance downstream in $t_1$ hours and returns the same distance upstream in $t_2$ hours. If the speed of the stream be $y$ Km/h, then the speed of the man in still water is given by

$$y\left(\frac{t_2+t_1}{t_2-t_1}\right) \text{ Km/h.}$$

**Explanation:**

Let, the speed of the man in still water be $x$ Km/h.

Then, downstream speed = $(x + y)$ Km/h

and upstream speed = $(x - y)$ Km/h.

Since the distance covered downstream and upstream are equal, we have

$$(x + y)t_1 = (x - y)t_2$$

or, $\quad xt_1 + yt_1 = xt_2 - yt_2$

or, $\quad x(t_2 - t_1) = y(t_2 + t_1)$

$$\therefore \quad x = y\left(\frac{t_2+t_1}{t_2-t_1}\right) \text{ Km/h.}$$

**Illustration 5:** A motorboat covers a certain distance downstream in 6 hours, but takes 8 hours, to return upstream to the starting point. If the speed of the stream be 6 Km/h, find out the speed of the motor boat in still water.

**Solution:** Speed of the motorboat in still water

$$= y\left(\frac{t_2+t_1}{t_2-t_1}\right) \text{ Km/h}$$

$$= 6\left(\frac{8+6}{8-6}\right) = 42 \text{ Km/h.}$$

4. A man can row a boat in still water at $x$ Km/h. In a stream flowing at $y$ Km/h if it takes him $t$ hours to row to a place and come back, then the distance between the two places is

$$\frac{t(x^2-y^2)}{2x} \text{ Km.}$$

**Explanation:**

Downstream speed = $(x + y)$ Km/h

Upstream speed = $(x - y)$ Km/h.

Let, the distance between the two places be $d$ Km. We have,

Total time = Sum of time taken downstream and upstream

$$\Rightarrow \quad t = \frac{d}{x+y} + \frac{d}{x-y}$$

$$= d\left[\frac{(x-y)+(x+y)}{(x-y)(x+y)}\right]$$

$$= d\left[\frac{2x}{x^2-y^2}\right]$$

$$\therefore \quad d = \frac{t(x^2-y^2)}{2x} \text{ Km.}$$

**Illustration 6:** A man can row 6 Km/h in the still water. If the river is running at 2 Km/h, it takes him 3 hours to row to a place and back. How far is the place?

**Solution:** The required distance

$$= \frac{t(x^2 - y^2)}{2x} \text{ Km} = \frac{3(36-4)}{2\times 6} = 8 \text{ Km}.$$

5. A boat (or a swimmer) takes $n$ times as long to row upstream as to row downstream the river. If the speed of boat (or swimmer) be $x$ Km/h and the speed of stream be $y$ Km/h, then

$$x = y\left(\frac{n+1}{n-1}\right).$$

**Illustration 7:** A man can row at the rate of 4 Km/h in still water. If the time taken to row a certain distance upstream is 3 times as much as to row the same distance downstream, find the speed of the current.

**Solution:** We have

Speed of the man $= \left(\frac{n+1}{n-1}\right)$ speed of the current

$\Rightarrow \quad 4 = \left(\frac{3+1}{3-1}\right)$ speed of the current.

$\therefore$ Speed of the current = 2 Km/h.

## EXERCISE-I

**1.** A boat goes 13 Km upstream in 39 minutes. The speed of stream is 3 Km/h. The speed of boat in still water is:

(a) 23 Km/h (b) 27 Km/h
(c) 25 Km/h (d) None of these

**2.** The speed of a boat in still water is 8 Km/h. If its speed downstream be 15 Km/h, then speed of the stream is:

(a) 7.5 Km/h (b) 7 Km/h
(c) 9 Km/h (d) None of these

**3.** Speed of a man is 10 Km/h in still water. If the rate of current is 3 Km/h, then the effective speed of the man upstream is:

(a) 7 Km/h (b) 8.5 Km/h
(c) 9 Km/h (d) None of these

**4.** A man can row with the stream at 7 Km/h and against the stream at 3 Km/h. His speed in still water is:

(a) 6.5 Km/h (b) 7 Km/h
(c) 5 Km/h (d) None of these

**5.** A swimmer covers a distance of 28 Km against the current and 40 Km in the direction of the current. If in each case he takes 4 hours, then the speed of the current is:

(a) 3.5 Km/h (b) 1.5 Km/h
(c) 2.5 Km/h (d) None of these

**6.** A boat moves downstream at the rate of one Km in 10 minutes and upstream at the rate of 4 Km an hour. What is the velocity of the current:

(a) 5 Km/h (b) 3 Km/h
(c) 1 Km/h (d) None of these

**7.** If a man's rate with the current is 12 Km/h and the rate of the current is $1\frac{1}{2}$ Km/h, then his rate against the current is:

(a) 13 Km/h (b) 7 Km/h
(c) 9 Km/h (d) None of these

**8.** A boatman can row 2 Km against the stream in 20 minutes and return in 18 minutes. Find the rate of current.

(a) $\frac{1}{3}$ Km/h (b) $\frac{2}{3}$ Km/h
(c) $\frac{1}{3}$ Km/h (d) None of these

**9.** A boatman can row 48 Km downstream in 4 hours. If the speed of the current is 5 Km/h, then find in what time will he be able to cover 8 Km upstream?

(a) 6 hours (b) 4 hours
(c) 8 hours (d) None of these

**10.** A man can row at a speed of 10 Km/h in still water to a certain upstream point and back to the starting point in a river which flows at 4 Km/h. Find his average speed for total journey.

(a) $9\frac{2}{5}$ Km/h (b) $8\frac{2}{5}$ Km/h
(c) $11\frac{2}{5}$ Km/h (d) None of these

**11.** A man can row 6 Km/h in still water. If the river is running at 2 Km/h, it takes 3 hours more in upstream than to go downstream for the same distance. How far is the place?

(a) 24 Km (b) 28 Km
(c) 36 Km (d) None of these

**12.** A boat covers a certain distance downstream in 2 hours, but takes 4 hours to return upstream to the starting point. If the speed of the stream be 3 Km/h, find the speed of the boat in still water.

(a) 11 Km/h (b) 13 Km/h
(c) 9 Km/h (d) None of these

**13.** In a river flowing at 2 Km/h, a boat travels 32 Km upstream and, then returns downstream to the starting point. If its speed in still water be 6 Km/h, find out the journey time.

(a) 16 hours (b) 12 hours
(c) 12 hours (d) None of these

**14.** A boat travels upstream from B to A and downstream from A to B in 3 hrs. If the speed of the boat in still water is 9 Km/h and the speed of the current is 3 Km/h, the distance between A and B is:

(a) 8 Km (b) 16 Km
(c) 12 Km (d) None of these

**15.** A boat travels 2 Km upstream in a stream flowing at 3 Km/h and, then returns downstream to the starting point in 30 minutes. The speed of the boat in still water is:

(a) 17 Km/h (b) 9 Km/h
(c) 13 Km/h (d) None of these

**16.** A man swimming in a stream which flows $1\frac{1}{2}$ Km/h finds that in a given time he can swim twice as far with the stream as he can against it. At what rate does he swim?

(a) $4\frac{1}{2}$ Km/h (b) $5\frac{1}{2}$ Km/h
(c) $7\frac{1}{2}$ Km/h (d) None of these

**17.** A boat travels upstream from B to A and downstream from A to B in 3 hours. If the speed of the boat in still water is 9 Km/h and the speed of the current is 3 Km/h, the distance between A and B is:

(a) 4 Km (b) 6 Km
(c) 8 Km (d) 12 Km

**18.** A man rows upstream 12 Km and downstream 28 Km taking 5 hours each time. The velocity of water current is:

(a) $2\frac{1}{5}$ Km/h (b) $2\frac{1}{2}$ Km/h
(c) 3 Km/h (d) $1\frac{3}{5}$ Km/h

**19.** Twice the speed downstream is equal to the thrice the speed upstream, the ratio of speed in still water to the speed of the current is:

(a) 1:5 (b) 5:1
(c) 1:3 (d) 2:3

**20.** A man can swim 3 Km/h in still water. If the velocity of the stream be 2 Km/h, the time taken by him to swim to a place 10 Km upstream and back, is:

(a) $8\frac{1}{3}$ hours (b) $9\frac{1}{5}$ hours
(c) 10 hours (d) 12 hours

**21.** A boat covers 24 Km upstream and 36 Km downstream in 6 hours, while it covers 36 Km upstream and 24 Km downstream in $6\frac{1}{2}$ hours. The velocity of the current is:

(a) 1.5 Km/h (b) 1 Km/h
(c) 2 Km/h (d) 2.5 Km/h

**22.** A boatman goes 2 Km against the current of the stream in 1 h and goes 1 Km along the current in 10 min. How long will he take to go 5 Km in stationary water?

(a) 1 hour (b) 1 hour 15 minutes
(c) $1\frac{1}{2}$ hours (d) 40 minutes

**23.** P, Q, R are three towns on a river which flows uniformly. Q is equidistant from P and R. A man rows from P to Q and returns in 10 h. He can row from P to R in 4 h. The ratio of speed of the man in still water to the speed of the current is:

(a) 5:3 (b) 3:5
(c) 2:5 (d) 1:2

**24.** In a stream running at 2 Km/h, a motor boat goes 10 Km upstream and returns to the starting point in 55 min. Find out the speed of the motorboat in still water.

(a) 20 Km/h (b) 21 Km/h
(c) 22 Km/h (d) 24 Km/h

**25.** A man can row 30 Km upstream and 44 Km downstream in 10 hours. Also, he can row 40 Km upstream and 55 Km downstream in 13 hours. Find the rate of the current and the speed of the man in still water.

(a) 3 Km/h, 8 Km/h
(b) 3·5 Km/h, 7·5 Km/h
(c) 4 Km/h, 7 Km/h
(d) 4·5 Km/h, 6·5 Km/h

## Exercise-2
## (Based on Memory)

**1.** The speed of a motor-boat is to that of the current of water as 36:5. The boat goes along with the current in 5 hours 10 minutes. It will come back in:

(a) 5 hours 50 minutes
(b) 6 hours
(c) 6 hours 50 minutes
(d) 12 hours 10 minutes

**[SSC (GL) Prel. Examination, 2007]**

**2.** A boat goes 8 Km in 1 h along the stream and 2 Km in 1 h against the stream. The speed of the stream (in Km/h) is:

(a) 2 (b) 3
(c) 4 (d) 5

**[SSC (GL) Prel. Examination, 2000]**

**3.** A man rows a boat 18 Km in 4 h downstream and returns upstream in 12 h. The speed of the stream (in Km/h):

(a) 1 (b) 1.5
(c) 2 (d) 1.75

**[SSC (GL) Prel. Examination, 2003]**

**4.** A boat takes 6 hours to travel from place M to N downstream and back from N to M upstream. If the speed of the boat in still water is 4 Km/h, what is the distance between the two places?

(a) 8 Km (b) 12 Km
(c) 6 Km (d) Date inadequate
(e) None of these

**[SSC (GL) Prel. Examination, 2000]**

**5.** A person can swim at $7\frac{1}{2}$ Km/h in stagnant water. In a river with 1·5 Km/h current, the person swims to a certain distance and comes back within 50 min. What is the distance between the two points?

(a) 3 Km (b) 4 Km
(c) 1 Km (d) 2 Km

**[RRB Mahendraghat Patna Goods Guard Examination, 2002]**

**6.** A boat takes 9 h to travel a distance upstream and 3 h to travel the same distance downstream. If its speed in still water is 4 Km/h, what is the velocity of the stream?

(a) 4 Km/h (b) 3 Km/h
(c) 6 Km/h (d) None of these

**[DMRC Examination, 2002]**

**7.** A boat goes 20 Km downstream in 1 h and the same distance upstream in 2 h. The speed of the boat in still water is:

(a) 15 Km/h (b) 10 Km/h
(c) 5 Km/h (d) 7.5 Km/h

**[SSC CPO (SI) Prel. Examination, 2003]**

**8.** A boat takes 4 hours for travelling downstream from point A to point B and coming back to point A upstream. If the velocity of the stream is 2 Km/h and the speed of the boat in still water is 4 Km/h, then what is the distance between A and B?

(a) 8 Km (b) 9 Km
(c) 4 Km (d) 6 Km

**[RRB Allahabad ASM Examination, 2002]**

**9.** A boat takes 9 hours to travel a distance upstream and takes 3 hours to travel the same distance downstream. If the speed of the boat in still water is 4 Km/h, then what is the velocity of the stream?

(a) 4 Km/h (b) 3 Km/h
(c) 6 Km/h (d) 2 Km/h
(e) None of these

**[RRB Bhubaneshwar ASM Examination, 2002]**

**10.** A boat running downstream covers a distance of 16 Km in 2 hours while for covering the same distance upstream it takes 4 hours. What is the speed of the boat in still water?

(a) 4 Km/h (b) 6 Km/h
(c) 8 Km/h (d) Data inadequate
(e) None of these

**[SBI Associates Bank PO, 2002]**

**11.** A boat has to travel upstream 20 Km distance from point X of a river to point Y. The total time taken by boat in travelling from point X to Y and Y to X is 41 minutes 40 second. What is the speed of the boat?

(a) 66 Km/h (b) 72 Km/h
(c) 48 Km/h (d) Data inadequate
(e) None of these

**[BSRB Hyderabad PO, 1999]**

**12.** A boat takes 2 h to travel from point A to B in still water. To find out its speed upstream, which of the following information is/are required?

A. Distance between point A and B.
B. Time taken to travel downstream from B to A.
C. Speed of the stream of water.

D. Effective speed of boat while travelling downstream from B to A.

(a) All are required
(b) Even with all these, the answer cannot be determined
(c) Only A, C and either B or D
(d) Only A, C and D
(e) None of these

**[BSRB Bhopal Bank PO, 2000]**

**13.** A man can row 6 Km/h in still water. If the speed of the current is 2 Km/h, it takes 3 hrs more in upstream than in the downstream for the same distance. The distance is:

(a) 30 Km (b) 24 Km
(c) 20 Km (d) 32 Km

**[SSC (GL), 2011]**

**14.** A boat covers 12 Km upstream and 18 Km downstream in 3 hours, while it covers 36 Km upstream and 24 Km downstream in $6\frac{1}{2}$ hours. What is the speed of the current?

(a) 1.5 Km/h (b) 1 Km/h
(c) 2 Km/h (d) 2.5 Km/h

**[SSC, 2012]**

**15.** A motor-boat can travel at 10 Km/h in still water. It travelled 91 Km downstream in a river and then returned to the same place, taking altogether 20 hours. Find the rate of flow of river.

(a) 3 Km/h (b) 4 Km/h
(c) 2 Km/h (d) 5 Km/h

**[SSC, 2011]**

**16.** A motor-boat, travelling at the same speed, can cover 25 Km upstream and 39 Km downstream in 8 hours. At the same speed, it can travel 35 Km upstream and 52 Km downstream in 11 hours. The speed of the stream is:

(a) 2 Km/h (b) 3 Km/h
(c) 4 Km/h (d) 5 Km/h

**[SSC, 2011]**

**17.** A man can row against the current $\frac{3}{4}$ of a kilometre in 15 minutes and returns the same distance in 10 minutes. The ratio of his speed to that of the current is:

(a) 3:5 (b) 5:3
(c) 1:5 (d) 5:1

**[SSC, 2010]**

**Directions (Q. 18-19):** Each of the following questions consists of a question followed by three statements I, II and III. You have to study the question and the statements and decide which of the statement(s) is/are necessary to answer the question.

**18.** What is the speed of a boat in still water?

I. The boat covers 12 Km in 2 hours downstream.
II. The boat covers the same distance in 4 hoursupstream.
III. The speed of the stream is $\frac{1}{3}$ that of the boatin still water.

(a) Both I and II
(b) I and either II or III
(c) All I, II and III
(d) The question cannot be answered even with the information in all three statements.
(e) None of these

**[IBPS PO/MT, 2013]**

**19.** What is the speed of a train?

I. The length of the train is 240 meters.
II. The train crosses a pole in 24 seconds.
III. The train crosses a platform in 48 seconds.

(a) Both I and III (b) Both I and II
(c) Both II and III (d) Any two of the three
(e) None of these

**[IBPS PO/MT, 2013]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (b) | **3.** (a) | **4.** (c) | **5.** (b) | **6.** (c) | **7.** (c) | **8.** (a) | **9.** (b) | **10.** (b) | **11.** (a) | **12.** (c) | **13.** (b) |
| **14.** (c) | **15.** (b) | **16.** (a) | **17.** (d) | **18.** (d) | **19.** (b) | **20.** (d) | **21.** (c) | **22.** (b) | **23.** (a) | **24.** (c) | **25.** (a) | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (b) | **3.** (b) | **4.** (d) | **5.** (a) | **6.** (d) | **7.** (a) | **8.** (b) | **9.** (d) | **10.** (b) | **11.** (d) | **12.** (e) | **13.** (b) |
| **14.** (c) | **15.** (a) | **16.** (c) | **17.** (d) | **18.** (b) | **19.** (b) | | | | | | | |

# EXPLANATORY ANSWERS

## EXERCISE-I

**1.** **(a)** Speed of the boat upstream

$= \frac{13 \times 60}{39} = 20$ Km/h

Speed of the stream = 3 Km/h

Let, the speed of the boat in still water = $x$ Km/h.

We have, $x - 3 = 20$

$\therefore\ x = 20 + 3 = 23$ Km/h.

**2.** **(b)** Speed of the boat downstream = 15 Km/h.

Speed of the boat in still water = 8 Km/h.

Let the speed of the stream = $y$ Km/h.

We have, $15 = 8 + y \quad \therefore \quad y = 15 - 8 = 7$ Km/h.

**3.** **(a)** Speed of man in still water = 10 Km/h

Speed of current = 3 Km/h $\therefore$ Speed of man upstream $= 10 - 3 = 7$ Km/h.

**4.** **(c)** Speed of the man upstream = 7 Km/h.

Speed of the man downstream = 3 Km/h.

$\therefore$ Speed of the man in still water

$= \frac{1}{2}$ (Downstream Speed + Upstream Speed)

$= \frac{1}{2}(7 + 3) = 5$ Km/h.

**5.** **(b)** Speed of the swimmer upstream

$= \frac{28}{4} = 7$ Km/h.

Speed of the swimmer downstream

$= \frac{40}{4} = 10$ Km/h.

$\therefore$ Speed of the stream

$= \frac{1}{2}$ (Downstream Speed − Upstream Speed)

$= \frac{1}{2}(10 - 7) = \frac{3}{5} = 1{\cdot}5$ Km/h.

**6.** **(c)** Speed of the boat downstream

$= \frac{60}{10} = 6$ Km/h.

Speed of the boat upstream = 4 Km/h

$\therefore$ Velocity of the current

$= \frac{1}{2}$ (Downstream speed − Upstream Speed)

$= \frac{1}{2}(6 - 4) = 1$ Km/h.

**7.** **(c)** Speed of the man downstream = 12 Km/h.

Speed of the stream $= \frac{3}{2}$ Km/h.

Let, the speed of the man upstream = $x$ Km/h.

We have,

Speed of the stream

$= \frac{1}{2}$ (Downstream Speed − Upstream Speed)

$\Rightarrow\ \frac{3}{2} = \frac{1}{2}(12 - x).$

$\therefore\ x = 12 - 3 = 9$ Km/h.

**8.** **(a)** Speed of the boatman upstream

$= \frac{2}{20} \times 60 = 6$ Km/h.

Speed of the boatman downstream

$= \frac{2}{18} \times 60 = \frac{20}{3}$ Km/h.

$\therefore$ Rate of the current

$= \frac{1}{2}$ (Downstream Speed − Upstream Speed)

$= \frac{1}{2}\left(\frac{20}{3} - 6\right) = \frac{1}{3}$ Km/h.

**9.** **(b)** Speed of the boatman downstream

$= \frac{48}{4} = 12$ Km/h.

Speed of the current = 5 Km/h.

Let, the boatman takes $t$ hours to cover 8 Km upstream.

Then, speed of the current

$= \frac{1}{2}$ (Downstream Speed − Upstream Speed)

$\Rightarrow\ 5 = \frac{1}{2}\left(12 - \frac{8}{t}\right)$

$\therefore\ t = 4$ hours.

**10.** **(b)** Average Speed

$= \frac{\text{Upstream} \times \text{Downstream}}{\text{Man's rate in still water}}$

$= \frac{(10-4)(10+4)}{10} = 8\frac{2}{5}$ Km/h.

**11.** **(a)** The required distance

$= \frac{(x^2 - y^2)t}{2y} = \frac{(36-4)3}{2 \times 2} = 24$ Km.

**12.** **(c)** Speed of the boat in still water

$= y\left(\frac{t_2 + t_1}{t_2 - t_1}\right)$ Km/h

$= 3\left(\frac{4+2}{4-2}\right) = 9$ Km/h.

**13.** **(b)** Let, the total journey time be $t$ hours.

Then, we have $d = \frac{t(x^2 - y^2)}{2x}$

$\Rightarrow\ 32 = \frac{t(36-4)}{2 \times 6}$

$\therefore\ t = 12$ hours.

**14.** **(c)** The distance between A and B is

$= \dfrac{t(x^2 - y^2)}{2x}$ Km

$= \dfrac{3(81 - 9)}{2 \times 9} = 12$ Km.

**15.** **(b)** Let, the speed of the boat be $x$ Km/h.

We have,

$d = \dfrac{t(x^2 - y^2)}{2x}$

$\Rightarrow \quad 2 = \dfrac{1/2(x^2 - 9)}{2x}$, i.e., $2 = \dfrac{x^2 - 9}{4x}$

or, $x^2 - 8x - 9 = 0$

or, $(x - 9)(x + 1) = 0$

or, $x = -1$ or 9.

Since the speed cannot be negative, we neglect $-1$.

Therefore, speed of the boat in still water = 9 Km/h.

**16.** **(a)** Speed of the man

$= \left(\dfrac{n+1}{n-1}\right)$ speed of stream

$= \left(\dfrac{2+1}{2-1}\right) \times \dfrac{3}{2} = \dfrac{9}{2}$ or $4\dfrac{1}{2}$ Km/h.

**17.** **(d)** Speed downstream = $(9 + 3)$ Km/h

= 12 Km/h

Speed upstream = $(9 - 3)$ Km/h = 6 Km/h

Let, the distance AB = $x$ Km

Then, $\dfrac{x}{6} + \dfrac{x}{12} = 3 \quad \Rightarrow \quad 2x + x = 36$

$\Rightarrow \quad x = 12$

$\therefore$ Distance AB = 12 Km.

**18.** **(d)** Let, the man's rowing speed in still water = $x$ Km/h and speed of the current = $y$ Km/h

Speed upstream = $(x - y)$ Km/h

and, speed downstream = $(x + y)$ Km/h

$\therefore \quad 5(x - y) = 12$ and $5(x + y) = 28$

Subtracting $10y = 16$

$\therefore \quad y = \dfrac{8}{5} = 1\dfrac{3}{5}$ Km/h.

**19.** **(b)** Let, speed in still water = $x$ Km/h.

Speed of current = $y$ Km/h.

Speed downstream = $(x + y)$ Km/h.

Speed upstream = $(x - y)$ Km/h.

$\therefore \quad 2(x + y) = 3(x - y)$

$\therefore \quad x = 5y$

or, $\dfrac{x}{y} = \dfrac{5}{1}$ or 5:1.

**20.** **(d)** Speed upstream = $(3 - 2)$ Km/h = 1 Km/h.

Speed downstream = $(3 + 2)$ Km/h = 5 Km/h.

Total time taken = $\left(\dfrac{10}{1} + \dfrac{10}{5}\right)$ hours

= 12 hours.

**21.** **(c)** Let, the speed upstream be $x$ Km/h and the speed downstream by $y$ Km/h. Then,

$\dfrac{24}{x} + \dfrac{36}{y} = 6 \quad \Rightarrow \quad 24u + 36v = 6$

where, $\dfrac{1}{x} = u$ and $\dfrac{1}{y} = v$

And, $\dfrac{36}{x} + \dfrac{24}{y} = \dfrac{13}{2} \quad \Rightarrow \quad 36u + 24v = \dfrac{13}{2}$

Adding these equations, we get

$60(u + v) = \dfrac{25}{2}$ or $u + v = \dfrac{5}{24}$

By subtracting, we get $12(u - v) = \dfrac{1}{2}$ or, $u - v = \dfrac{1}{24}$

Solving, $u + v = \dfrac{5}{24}$ and $u - v = \dfrac{1}{24}$, we get

$u = \dfrac{1}{8}$ and $v = \dfrac{1}{12}$

$\therefore \quad x = 8$ Km/h and $y = 12$ Km/h

$\therefore \quad$ Velocity of current = $\dfrac{1}{2}(12 - 8) = 2$ Km/h.

**22.** **(b)** Upstream speed = 2 Km/h

Downstream speed = 6 Km/h

$\therefore \quad$ Speed in still water = $\dfrac{2+6}{2} = 4$ Km/h

$\therefore \quad$ Time required to go 5 Km in still water

$= \dfrac{5}{4}$ hours = 1 hours 15 minutes.

**23.** **(a)** Let, the speed of man in still water = $x$ Km/h

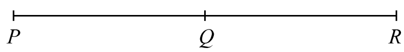
Speed of the current = $y$ Km/h

Speed downstream = $(x + y)$ Km/h

Speed upstream = $(x - y)$ Km/h

Let, the river be flowing from $P$ to $R$ and $PQ = QR = a$.

Then, $PR = 2a$




$$\therefore \quad \frac{a}{x+y} + \frac{a}{x-y} = 10. \qquad \cdots(1)$$

and, $\dfrac{2a}{x+y} = 4$

$$\therefore \quad \frac{a}{x+y} = 2 \qquad \cdots(2)$$

$$\therefore \quad (1) \Rightarrow \quad \frac{a}{x-y} = 8 \qquad \cdots(3)$$

By dividing Eqs. (2) and (3), we get $\dfrac{x-y}{x+y} = \dfrac{1}{4}$

$\therefore \quad 4x - 4y = x + y$

or, $3x = 5y$

or, $\dfrac{x}{y} = \dfrac{5}{3}$ or 5:3.

**24.** **(c)** Let, the speed of the motorboat in still water be $x$ Km/h

$$\frac{10}{x+2}+\frac{10}{x-2}=\frac{55}{60}$$

or, $240x = 11x^2 - 44$

or, $11x^2 - 240x - 44 = 0$

$\therefore$ $(x - 22)(11x + 2) = 0$

So, $x = 22$ Km/h (neglecting the –ve value)

$\therefore$ Speed of the motorboat in still water = 22 Km/h.

**25.** **(a)** Let, upstream speed = $x$ Km/h and downstream speed = $y$ Km/h

Then, $\frac{30}{x}+\frac{44}{y} = 10$, and $\frac{40}{x}+\frac{55}{y} = 13$

or, $30u + 44v = 10$, and $40u + 55v = 13$,

where $u = \frac{1}{x}$ and $v = \frac{1}{y}$

Solving, we get $u = \frac{1}{5}$ and $v = \frac{1}{11}$ $\therefore$ $x = 5$ and $y = 11$

$\therefore$ Rate in still water = $\frac{5+11}{2}$ = 8 Km/h

Rate of current = $\frac{11-5}{2}$ = 3 Km/h.

## EXERCISE-2
## (BASED ON MEMORY)

**2.** **(b)** Let, the speed of the stream be $y$ Km/h, and speed of the boat in still water be $x$ Km/h.

$\therefore$ $x + y = 8$ and $x - y = 2$ $\Rightarrow$ $y = 3, x = 5$.

**3.** **(b)** Let, $x$ Km/h and $y$ Km/h be respective speeds of boat and stream, then

$$x + y = \frac{18}{4} = 4.50 \qquad \cdots(1)$$

$$x - y = \frac{18}{12} = 1.50 \qquad \cdots(2)$$

Solving Eqs. (1) and (2), we get $x = 3$, $y = 1.5$.

**4.** **(d)** Total time = 6 hours

Speed of the boat in still water = 4 Km/h

Let, the distance between M and N be D kms.

Let, speed of the stream be $x$ Km/h

$$D\left[\frac{1}{4+x}+\frac{1}{4-x}\right] = 6$$

or, $D\left[\frac{4-x+4+x}{4^2-x^2}\right] = 6$ or, $\frac{8D}{16-x^2} = 6$

or, $D = \frac{6}{8}(16 - x^2) = \frac{3}{4}(16 - x^2)$

Since, the speed of the stream ($x$) is not given, the distance D cannot be determined.

**5.** **(a)** Speed in still water, S = 7.5 Km/h

Speed of current, Z = 1.5 Km/h

Upstream speed = S – Z = 6 Km/h

Downstream speed = S + Z = 9 Km/h

Let, the distance between the two points be $x$ Km

$\therefore$ Total journey time = $\frac{x}{6}+\frac{x}{9}=\frac{50}{60}$

or, $x\left(\frac{3+2}{18}\right)=\frac{5}{6}$ or $x = \frac{5}{6}\times\frac{18}{5}$ = 3 Km.

**6.** **(d)** Let, the distance one way be $x$ Km and stream speed be $Z$ Km/h.

Then, $x = 9(4 - Z) = 3(4 + Z)$

or, $3(4 - Z) = 4 + Z$ or, $12 - 3Z = 4 + Z$

or, $4Z = 8$ or, $Z = 2$ Km/h.

**7.** **(a)** Let, the speed of the boat in still water = $x$ Km/h, and the rate of stream = $y$ Km/h.

$\therefore$ Downstream rate = $(x + y)$ Km/h

Upstream rate = $(x - y)$ Km/h

Now, $\frac{20}{x+y} = 1$

or, $x + y = 20$ $\cdots(1)$

and, $\frac{20}{x-y} = 2$ or, $x - y = 10$ $\cdots(2)$

Solving (1) and (2), we get $x = 15$ Km/h.

**8.** **(b)** Let, the distance between A and B be $x$ Km

Rate upstream = 4 – 2 = 2 Km/h

Rate downstream = 4 + 2 = 6 Km/h

As per the question, $\frac{x}{2}+\frac{x}{6} = 4$ or, $\frac{3x+x}{6} = 6$

or, $x = 9$ Km.

**9.** **(d)** Let, the velocity of the stream be $x$ Km/h.

Then, the speed downstream = $(4 + x)$ Km/h, and the speed upstream = $(4 - x)$ Km/h.

$\because$ Distance covered downstream and upstream is equal

$\therefore$ $3(4 + x) = 9(4 - x)$

or, $12 + 3x = 36 - 9x$

or, $12x = 24$ or, $x = 2$.

**10.** **(b)** Rate upstream = $\frac{16}{2}$ Km/h = 8 Km/h.

Rate downstream = $\frac{16}{4}$ = 4 Km/h.

$\therefore$ Rate in still water = $\frac{1}{2}$ (8 + 4) = 6 Km/h.

**11.** **(d)** Let, $x$ be the speed of the boat, and $y$ be the speed of the current.

$$\therefore \quad \frac{20}{x-y}+\frac{20}{x+y}=\frac{25}{36}$$

In the equation, there are two variables, but only one equation, so, the value of '$x$' cannot be determined.

**13.** **(b)** Let, the required distance be $x$ Km.

$$\therefore \quad \frac{x}{6-2}-\frac{x}{6+2} = 3$$

$$\Rightarrow \quad \frac{x}{4}-\frac{x}{8} = 3$$

$$\Rightarrow \quad \frac{x}{8} = 3$$

$\therefore$ $x$ = 24 km

**14.** **(c)** Let, the speed of boat in still water be $x$ Km/h and that of current be $y$ Km/h.

Now, according to the question,

$$\frac{12}{x-y}+\frac{18}{x+y}=3 \quad \cdots(1)$$

$$\frac{36}{x-y}+\frac{24}{x+y}=\frac{13}{2} \quad \cdots(2)$$

By equation (1) × 3 – equation (2),

$$\frac{54}{x+y}-\frac{24}{x+y}=9-\frac{13}{2}$$

$$\Rightarrow \quad \frac{30}{x+y}=\frac{5}{2} \quad \Rightarrow \quad x+y=12 \quad \cdots(3)$$

From equation (1),

$$\frac{12}{x-y}+\frac{18}{12}=3$$

$$\Rightarrow \quad \frac{12}{x-y}=3-\frac{3}{2}=\frac{3}{2}$$

$$x-y=\frac{12\times 2}{3}=8 \quad \cdots(4)$$

$\therefore$ Speed of current $=\frac{1}{2}(12-8)=2$ Km/h

**15.** **(a)** Let, the rate of stream be $x$ Km/h.

$\therefore$ Rate downstream = (10 + $x$) Km/h

Rate upstream (10 – $x$) Km/h

Now, according to the question,

$$\frac{91}{10+x}+\frac{91}{10-x}=20$$

$$\Rightarrow \quad 91\left(\frac{10-x+10+x}{(10+x)(10-x)}\right)=20$$

$$\Rightarrow \quad (10+x)(10-x)=91$$

$$\Rightarrow \quad 100-x^2=91$$

$$\Rightarrow \quad x^2=100-91=9$$

$$\therefore \quad x=\sqrt{9}=3 \text{ Km/h}$$

**16.** **(c)** Let, speed of motorboat in still water be $x$ Km/h and speed of stream be $y$ Km/h.

Now, according to the question,

$$\frac{25}{x-y}+\frac{39}{x+y}=8 \quad \cdots(1)$$

$$\frac{35}{x-y}+\frac{52}{x+y}=11 \quad \cdots(2)$$

By equation (1)×4 – (2)×3, we have $\frac{100}{x-y}-\frac{105}{x-y}=32-33$

$$\Rightarrow \quad \frac{-5}{x-y}=-1 \Rightarrow x-y=5 \quad \cdots(3)$$

Form equation (1),

$$\frac{25}{5}+\frac{39}{x+y}=8$$

$$\Rightarrow \quad \frac{39}{x+y}=8-5=3$$

$$\Rightarrow \quad x+y=13 \quad \cdots(4)$$

By equation (4) – (5)

$$x+y-x+y=13-5=8$$

$$\Rightarrow \quad 2y=8$$

$$\Rightarrow \quad y=\left(\frac{8}{2}\right)=4 \text{ Km/h}$$

**17.** **(d)** $\therefore$ The distance covered in $\frac{1}{4}$ hours (opposite to current) $=\frac{3}{4}$ Km

$\therefore$ Speed opposite to current ($x$) = 3 Km/h.

The distance covered in $\frac{1}{6}$ hours (with the current) $=\frac{3}{4}$ Km.

$\therefore$ Speed (with the current) ($y$) = 4.5 Km/h.

$\therefore$ Speed of boat $=\frac{x+y}{2}=\frac{3+4.5}{2}=3.75$ Km/h

$\therefore$ Speed of current $=\frac{y-x}{2}=\frac{4.5-3}{2}$ = 0.75 Km/h.

$\therefore$ Required ratio = 3.75:0.75 = 5:1

**18.** **(b)** Let, the speed of the boat be $u$ and that of the streambe $v$.

Then speed of boat downstream = $u$ + $v$

**From statement I.**

$$u+v=\frac{12}{2}=6 \text{ Km/h} \quad \cdots(1)$$

And speed of boat upstream = $u - v$

**From statement II.**

$$u - v = \frac{12}{4} = 3 \text{ Km/h} \qquad \cdots(2)$$

**From statement III**

$$v = \frac{u}{3} \qquad \cdots(3)$$

**From statement I and II**

$$u + v = 6$$

$$\begin{array}{r} u - v = 3 \\ \hline 2u = 9 \end{array}$$

$$\therefore \quad u = \frac{9}{2} = 4.5 \text{ Km/h}$$

**From statement I and III**

$$u + \frac{u}{3} = 6 \quad \text{or,} \quad 4u = 18$$

$$u = \frac{18}{4} = 4.5 \text{ Km/h}$$

Hence, statement I and either II or III is sufficient to answer the question.

**19.** **(b)** **From statement I.** The length of the train = 240 m. Again, time is not given in the statement.

Hence, I alone is not sufficient.

**From II.** Time taken by the train to cross a pole is 24 seconds.

But the length (distance) is not given in the statement.

Hence, statement II alone is not sufficient.

**From III.** Time taken by the train to cross the platform is 48 seconds.

But the lengths of the train and the platform are not given.

Therefore, statement III alone is not sufficient.

Now, on combining statements I and II,we get

$$\text{Speed of the train } = \frac{240}{24} = 10 \text{ m/s}$$

Hence, both I and II together are sufficient to answer the question.

# Races and Games of Skill

# 14

## INTRODUCTION

**Race:** A contest of speed in running, driving, riding sailing or rowing over a specified distance is called *race*.

**Race Course:** The ground or path on which contests are arranged is called a *race course*.

**Starting Point:** The point from where a race begins is called the *starting point*.

**Winning Post (or Goal):** The point where the race finishes is called the *winning post* or *finishing point* or *goal*.

**Dead-heat Race:** If all the persons contesting a race reach the finishing point exactly at the same time, then the race is called a *dead-heat race*.

**Winner:** The person who first reaches the finishing point is the *winner*.

Suppose, A and B are two contestants in a race. We give here certain statements and their corresponding mathematical meanings, which are frequently used:

| Statements | Mathematical Interpretation |
|---|---|
| **1.** A beats B by $t$ seconds | A finishes the race $t$ seconds before B finishes. |
| **2.** A gives B a start of $t$ seconds | A starts $t$ seconds after B starts from the same point. |
| **3.** A gives B a start of $x$ metres | While A starts at the starting point, B starts $x$ metres ahead from the starting point at the same time. |
| **4.** Game of 100 | A game in which the participant scoring 100 points first is the winner. |
| **5.** In a game of 100, 'A can give B 20 points' | While A scores 100 points, B scores only (100–20) or 80 points. |

## SOME USEFUL SHORTCUT METHODS

1. If A is $n$ times as fast as B and A gives B a start of $x$ metres, then the length of the race course, so that both A and B reach the winning post at the same time, must be

$$x\left(\frac{n}{n-1}\right) \text{ m}$$

**Illustration 1:** A is $1\frac{2}{3}$ times as fast as B. If A gives B a start of 60 m. How long should the race course be so that both of them reach at the same time?

**Solution:** Here, $n = \frac{5}{3}$ and $x = 60$.

$\therefore$ Length of the race course $= x\left(\frac{n}{n-1}\right)$

$$= 60\left(\frac{5/3}{5/3-1}\right) = 60\left(\frac{5}{5-3}\right) = 150 \text{ m}.$$

2. If A can run $x$ m race in $t_1$ seconds and B in $t_2$ seconds, where $t_1 < t_2$, then A beats B by a distance

$$\frac{x}{t_2}\times(t_2-t_1) \text{ m}.$$

**Illustration 2:** A can run 100 m in 27 seconds and B in 30 seconds. By what distance A beats B?

**Solution:** A beasts B by a distance

$$= \frac{x}{t_2}\times(t_2-t_1)$$

$$= \frac{100}{30}(30-27) = \frac{300}{30} = 10\text{ m}.$$

## EXERCISE-1

1. In a Km race A beats B by 25 m or 5 sec. Then find out the time taken by A to complete the race.
   (a) 3 minutes 15 seconds (b) 4 minutes 20 seconds
   (c) 2 minutes 30 seconds (d) 5 minutes 10 seconds
2. In a race of 300 m, A beats B by 15 m or 5 sec. A's time over the course is:
   (a) 100 seconds (b) 95 seconds
   (c) 105 seconds (d) 90 seconds
3. A can run 500 m in 30 seconds and B in 35 seconds. How many meter start can A give to B in a Km race so that the race may end in a dead-heat?
   (a) $139\frac{5}{7}$ (b) $138\frac{5}{7}$
   (c) $142\frac{6}{7}$ (d) $140\frac{5}{7}$
4. A runs $1\frac{3}{8}$ times as fast as B. If A gives B a start of 120 m and they reach the goal at the same time, the goal is at a distance of:
   (a) 360 m (b) 440 m
   (c) 460 m (d) 380 m
5. In a game of 100 points, A can give B 20 points and C 28 points. Number of points B can give C in a game of 100 points is:
   (a) 10 (b) 90
   (c) 15 (d) 85
6. A's speed is $1\frac{1}{2}$ times of B's. In a race A gives B a start of 300 m. How long should the race course be so that both reach the winning post simultaneously?
   (a) 700 m (b) 900 m
   (c) 800 m (d) 850 m
7. In a race of 600 m, A can beat B by 60 m and in a race of 500 m, B can beat C by 50 m. By how many m will A beat C in a race of 400 m?
   (a) 364 m (b) 254 m
   (c) 324 m (d) 354 m
8. In a 100 m race, A runs at 5 Km/h. A gives B a start of 8 m and still beats him by 8 sec. Find out the speed of B.
   (a) 6.14 Km/h (b) 4.14 Km/h
   (c) 3.14 Km/h (d) 2.14 Km/h
9. In a game, A can give B 20 points, A can give C 32 points and B can give C 15 points. How many points make the game?
   (a) 100 (b) 200
   (c) 300 (d) 400
10. At a game of billiards, A can give B 6 points in 50 and he can give C 13 in 65. In a game of 55, number of points B can give C is:
    (a) 3 (b) 4
    (c) 5 (d) 8
11. In a Km race A can beat B by 80 m and B can beat C by 60 m. In the same race, A can beat C by:
    (a) 135.2 m (b) 130.5 m
    (c) 142 m (d) 132.5 m
12. In a game of 90 points, A can give B 15 points and C 30 points. How many points can B give C in a game of 100 points?
    (a) 140 (b) 20
    (c) 50 (d) 30
13. In a race of 600 m, A can beat B by 60 m and in a race of 500 m, B can beat C by 50 m. By how many meter will A beat C in a race of 400 m?
    (a) 78 m (b) 56 m
    (c) 76 m (d) 86 m
14. In a game A can give B 25 points in 75 and C 18 points in 90. How many points can C give B in a game of 120?
    (a) 20 (b) 30
    (c) 40 (d) 50
15. A and B run a 5 Km race on a round course of 400 m. If their speeds be in the ratio 5:4, then how often does the winner pass the other?
    (a) $4\frac{1}{2}$ times (b) $3\frac{1}{2}$ times
    (c) $2\frac{3}{4}$ times (d) $2\frac{1}{2}$ times
16. In a 500 m race, the ratio of speeds of two contestants A and B is 3:4. A has a start of 140 m. Then, A wins by:
    (a) 60 m (b) 40 m
    (c) 20 m (d) 10 m

**17.** In a Km race A beats B by 100 m and C by 200 m. By how many can B beat C in a race of 1350 m?

(a) 150 m (b) 120 m
(c) 1200 m (d) 210 m

**18.** Two boys, A and B, runs at $4\frac{1}{2}$ and 6 Km an hour. A having 190 m start. The course being 1 Km, B wins by a distance of:

(a) 60 m (b) 65 m
(c) 45 m (d) 75 m

**19.** A and B runs a Km race. If A gives B a start of 50 m, A wins by 14 sec and, if A gives B a start of 22 sec Km, B wins by 20 m. The time taken by A to run a Km is:

(a) 100 sec (b) 120 sec
(c) 105 sec (d) 125 sec

**20.** A and B take part in a 100 m race. A runs at 5 Km/h. A gives B a start of 8 m and still beat him by 8 sec. Speed of B is:

(a) 5.15 Km/h (b) 4.14 Km/h
(c) 4.25 Km/h (d) 4.4 Km/h

## EXERCISE-2
## (BASED ON MEMORY)

**1.** A runner runs $1\frac{1}{4}$ laps of a 5 lap race. What fractional part of the race remains to be run?

(a) $\frac{15}{4}$ (b) $\frac{4}{5}$
(c) $\frac{5}{6}$ (d) $\frac{2}{3}$

**[SSC (GL) Prel. Examination, 2000]**

**2.** A, B and C start at the same time in the same direction to run around a circular stadium. A completes a round in 252 seconds, B in 308 seconds and C in 198 seconds, all starting at the same point. After what time will they meet next at the starting point again?

(a) 46 minutes 12 seconds
(b) 45 minutes
(c) 42 minutes 36 seconds
(d) 26 minutes 18 seconds

**[SSC (GL) Prel. Examination, 2003]**

**3.** From a point on a circular tract 5 Km long A, B and C started running in the same direction at the same time with speeds of $2\frac{1}{2}$ Km/h, 3 Km/h and 2 Km/h. respectively. Then on the starting point all three will meet again after:

(a) 30 hours (b) 6 hours
(c) 10 hours (d) 15 hours

**[SSC (GL) Prel. Examination, 2003]**

**4.** A can run a distance of 1 Km in 3 minutes 10 seconds and B can run the same distance in 3 minutes 20 seconds. If they start together, by what distance will A beat B?

(a) 50 m (b) 30 m
(c) 36 m (d) 60 m

**[SI of Police Rec. Examination, 1997]**

**5.** X and Y start from the same point and run around a circular stadium, whose circumference is 4200 m, at the rate of 500 m and 700 m per minute respectively, in the opposite directions. They will meet each other in:

(a) 3.5 minutes (b) 6.0 minutes
(c) 8.4 minutes (d) 21 minutes

**[SSC (GL) Prel. Examination, 1999]**

**6.** The respective ratio between the speeds of a car, a train and a bus is 5:9:4. The average speed of the car, the bus and the train is 72 Km/h together. What is the average speed of the car and the train together?

(a) 82 Km/h (b) 78 Km/h
(c) 84 Km/h (d) Cannot be determined

**[Punjab and Sindh Bank PO, 2010]**

**7.** Four runners started running simultaneously from a point on a circular track. They took 200 seconds, 300 seconds, 360 seconds and 450 seconds to complete one round. After how much time do they meet at the starting point for the first time?

(a) 1800 seconds (b) 3600 seconds
(c) 2400 seconds (d) 4800 seconds

**[SSC (GL) Examination, 2011]**

**8.** In a 100 m race, Kamal defeats Bimal by 5 seconds. If the speed of Kamal is 18 Km/h, then the speed of Bimal is:

(a) 15.4 Km/h (b) 14.5 Km/h
(c) 14.4 Km/h (d) 14 Km/h

**[SSC (GL) Examination, 2010]**

**9.** Raju runs 1250 meter on Monday and Friday. Another days he runs 1500 meter except for Sunday (He does not run on Sunday). How many kilometer will he run in 3 weeks (first day starting from Monday)?

(a) 12.5 Km (b) 20.5 Km
(c) 8.5 Km (d) 25.5 Km
(e) None of these

**[IOB PO, 2011]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (b) | **3.** (c) | **4.** (b) | **5.** (a) | **6.** (b) | **7.** (c) | **8.** (b) | **9.** (a) | **10.** (c) | **11.** (a) | **12.** (b) | **13.** (c) |
| **14.** (a) | **15.** (d) | **16.** (c) | **17.** (a) | **18.** (a) | **19.** (a) | **20.** (b) | | | | | | |

### Exercise-2

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (a) | **3.** (c) | **4.** (a) | **5.** (a) | **6.** (c) | **7.** (a) | **8.** (c) | **9.** (d) |

## EXPLANATORY ANSWERS

### Exercise-1

**1. (a)** B runs 25 m in 5 seconds.

$\therefore$ B's time to cover 1 Km $= \frac{5}{25} \times 100$

$= 200$ sec

A's time to cover one Km $= 200 - 5$

$= 195$ seconds

$= 3$ minutes 15 seconds.

**2. (b)** 15 m is covered by B in 5 sec

$\therefore$ 300 m is covered by B in $\frac{5}{15} \times 300 = 100$ seconds

$\therefore$ A takes $100 - 5 = 95$ seconds.

**3. (c)** Time taken by A to run 1 Km

$= 30 \times 2 = 60$ seconds.

Time taken by B to run 1 Km $= 35 \times 2 = 70$ seconds.

$\therefore$ A can give B a start of $(70 - 60) = 10$ seconds.

In 35 sec B runs 500 m

$\therefore$ In 10 sec B runs $= \frac{500}{35} \times 10 = \frac{1000}{7} = 142\frac{6}{7}$ m

So, A can give B a start of $142\frac{6}{7}$ metres in a Km race.

**4. (b)** The speed of A and B are in the ratio 11:8.

Let, speeds be $11s$ and $8s$ (in m/sec).

Let, race be of $x$ m.

Then, time taken by A to run $x$ m is same as that of B to run $(x - 120)$ m.

$\therefore \frac{x}{11s} = \frac{x-120}{8s}$ $\therefore 3x = 11 \times 120$

$\therefore x = 440.$

**5. (a)** A scores 100 while B scores $100 - 20 = 80$ and C scores $100 - 28 = 72$.

$\therefore$ While B scores 80, C scores 72.

$\therefore$ While B scores 100, C scores $\frac{72}{80} \times 100 = 90$.

$\therefore$ B can give C $100 - 90 = 10$ points.

**6. (b)** A's speed:B's speed

$= 1.\frac{1}{2}:1 = \frac{3}{2}:1 = 3:2$

It means that in a race of 3 m, A gains $(3 - 2)$.

$= 1$ m over B.

1 m is gained by A in a race of 3 m.

$\therefore$ 300 m is gained by A in a race of

$= \frac{3}{1} \times 300 = 900$ m.

**7. (c)** Clearly, if A runs 600 metres, B runs = 540 m.

$\therefore$ If A runs 400 m, B runs $= \left(\frac{540}{600} \times 400\right)$

$= 360$ m

Again, when B runs 500 m, C runs = 450 m

$\therefore$ When B runs 360 m, C runs

$= \left(\frac{450}{500} \times 360\right)$ m $= 324$ m.

**8.** **(b)** Time taken by A to cover 100 m

$= 100 \div \left(5 \times \frac{5}{18}\right) = 72$ seconds.

$\therefore$ B covers (100 – 8) or, 92 m in (72 + 8) or, 80 seconds.

$\therefore$ Speed of B $= \frac{92}{80} \times \frac{16}{5} = 4.14$ Km/h.

**9.** **(a)** Suppose, $x$ points make the game.

Clearly, when A scores $x$ points, B scores $(x - 20)$ points and C scores $(x - 32)$ points.

Now, when B scores $x$ points, C scores $(x - 15)$ points.

When B scores $(x - 20)$ points,

C scores $\left[\frac{(x-15)}{x} \times (x-20)\right]$ points

$\therefore \frac{(x-15)(x-20)}{x} = x - 20$ or, $x = 100$

Hence, 100 points make the game.

**10.** **(c)** In a game of 50.

While A scores 50, B scores 50 – 6 = 44 and in a game of 65.

While A scores 65, C scores 65 – 13 = 52.

$\therefore$ While A scores 50, C scores $\frac{52}{65} \times 50 = 40$.

$\therefore$ While B scores 44, C's score = 40.

While B scores 55, C's score $= \frac{40}{44} \times 55 = 50$.

$\therefore$ In a game of 55,

B can give C 55 – 50 = 5 points.

**11.** **(a)** While A runs 1000 m, B runs 1000 – 80 = 920 m and while B runs 1000 m, C runs 1000 – 60 =940 m.

$\therefore$ While B runs 920 m; C runs

$\frac{940}{1000} \times 920 = \frac{4324}{5}$ m

$\therefore$ While B runs 920 m; C runs

$\frac{940}{1000} \times 920 = \frac{4324}{5}$ m

$\therefore$ While A runs 1000 m, C runs $\frac{4324}{5}$ m

$\therefore$ A can beat C by $1000 - \frac{4324}{5} = \frac{676}{5} = 135\frac{1}{5}$ m.

**12.** **(b)** A:B:C = 90:75:60

$$B:C = \frac{75}{60} = \frac{70 \times \frac{100}{75}}{60 \times \frac{100}{75}} = \frac{100}{80}$$

Hence, in a game of 100 points, B can give C(100 – 80) = 20 points.

**13.** **(c)** If A runs 600 m, B runs 600 – 60 or, 540 m.

If A runs 400 m, B runs $= \frac{540 \times 400}{600} = 360$ m.

Now, when B runs 500 m, C runs 500 – 50 = 450 m.

$\therefore$ When B runs 360 m, C runs

$= \frac{450 \times 360}{500} = 324$ m

$\therefore$ A beats C by 400 – 324 = 76 m.

**14.** **(a)** When A scores 75 points, B scores 50 points.

When A scores 90 points, C scores (90 – 18) = 72 points.

$\therefore$ When A scores 75 points, C scores $= \frac{72}{90} \times 75 = 60$ points.

A:B:C = 75:50:60

C:B $= \frac{60}{50} = \frac{120}{100}$

So, in a game of 120, C can give B

(120 – 100) = 20 points.

**15.** **(d)** When A makes 5 rounds, B makes 4 rounds.

In order to pass each other, the difference in number of rounds made by each must be one. Here, A passes B each time, when A makes 5 rounds.

Distance covered by A in 5 rounds $= \frac{5 \times 400}{100} = 2$ Km.

In covering 2 Km, A passes B 1 time.

$\therefore$ In covering 5 Km, A passes B

$= \frac{5}{2} = 2\frac{1}{2}$ times.

**16.** **(c)** To reach the winning post, A will have to cover a distance of (500 – 140),

i.e., 360 m.

While A covers 3 m, B covers 4 m.

While A covers 360 m, B covers $\frac{4}{3} \times 360 = 480$ m.

So, A reaches the winning post while B remains 20 m behind.

$\therefore$ A wins by 20 m.

**17.** **(a)** While A runs 1000 m, B runs 1000 – 100 =900 m and C runs 1000–200= 800 m.

$\therefore$ While B runs 900 m, C runs 800 m.

$\therefore$ While B runs 1350 m; C runs $\frac{800}{900} \times 1350$

= 1200 m

$\therefore$ B can beat C by 1350 – 1200 = 150 m.

**18.** **(a)** Speeds (in m/sec) of A and B are

$\frac{9}{2} \times \frac{5}{18} = \frac{5}{4}$ and $6 \times \frac{5}{18} = \frac{5}{3}$, respectively.

A has a start of 190 m. So, A has to run 1000 – 190 = 810 m, while B 1000 m.

Time taken by B to cover 1000 m $= \frac{3}{5} \times 1000$

= 600 seconds.

In this time, A covers $\frac{5}{4} \times 600 = 750$ m.

So, B reaches the winning post while A remains 810 – 750 = 60 m behind.

$\therefore$ B wins by 60 m.

**19. (a)** Let, times (in sec) taken by A and B to run a Km, be $x$ and $y$, respectively.

When B gets a start of 50 m, B runs.

1000 – 50 = 950 m while A runs 1000 m.

$\therefore \quad \frac{950}{100}y - x = 14,$

i.e., $0.95y - x = 14$ ⋯(1)

and, when B gets a start of 22 seconds, A runs for $(y - 22)$ seconds, while B runs for $y$ seconds.

$\therefore \quad 1000 - \frac{1000}{x}(y - 22) = 20$

i.e., $50y - 49x = 1100.$ ⋯(2)

Multiplying Eq. (1) by 49 and subtract from Eq. (2)

$3.45y = 414$

$\therefore \quad y = 120$ sec.

$\therefore \quad (1) \Rightarrow x = 0.95 \times 120 - 14 = 100$ seconds.

**20. (b)** A's speed $= \left(5 \times \frac{5}{18}\right)$ m/sec $= \frac{25}{18}$ m/sec

Time taken by A to cover 100 m $= \left(100 \times \frac{18}{25}\right)$sec = 72 seconds.

$\therefore$ B covers 92 m in 72 + 8 = 80 seconds.

B's speed $= \left(\frac{92}{80} \times \frac{18}{5}\right)$Km/h = 4.14 Km/h.

## EXERCISE-2
## (BASED ON MEMORY)

**1. (a)** $5 - \frac{5}{4} = \frac{15}{4}$.

**2. (a)** L.C.M. of 252, 308 and 198 = 2772 seconds = 46 × 60 + 12 = 46 min 12 seconds.

**3. (c)** A will reach at starting point in $\frac{5 \times 2}{5}$ = 2 hours

B will reach at starting point in $\frac{5}{3}$ hours

C will reach at starting point in $\frac{5}{2}$ hours

Then, on the starting point all three will meet after the L.C.M. of 2, $\frac{5}{3}, \frac{5}{2} = \frac{10}{1}$ = 10 hours.

**6. (c)** Total speed of car, bus and train = 72 × 3 = 216 Km

Speed of car and train $= \frac{5+9}{5+9+4} \times 216 = 168$ Km

Average $= \frac{168}{2}$ = 84 Km

**7. (a)** Required = L.C.M. of 200, 300, 350 and 450 s = 1800 s

**8. (c)** Time taken by Kamal to run 100 m

$= \frac{100}{18 \times \frac{5}{18}} = 20$ s

Therefore, time taken by Bimal to run 100 m

= 20 + 5 = 25 s

Hence, Bimal's speed

$= \frac{100}{25} = 4$ m/sec

$= \frac{4 \times 18}{}$ Km/h = 14.4 Km/h

**9. (d)** Raju runs on Monday and Friday = 1250 × 2 = 2500 m

On Tuesday, Wednesday, Thursday and Saturday,

Raju runs 1500 × 4 = 6000 m

In 1 week Raju runs 6000 + 2500 = 8500 m

In 3 weeks Raju runs 3 × 8500 = 25500 m = 25.5 K

# Alligation or Mixture 15

## INTRODUCTION

Alligation literally means 'linking'. It is a rule to find:

(a) the ratio in which two or more ingredients at their respective prices should be mixed to give a mixture at a given price.

(b) The mean or average price of a mixture when the prices of two or more ingredients which may be mixed together and the proportion in which they are mixed are given.

Here, cost price of a unit quantity of a mixture is called the 'mean price'.

### Alligation Rule

Suppose, ₹$d$ per unit be the price of first ingredient (superior quality) mixed with another ingredient (cheaper quality) of price ₹$c$ per unit to form a mixture whose mean price is ₹$m$ per unit, then the two ingredients must be mixed in the ratio:

$$\frac{\text{Quantity of cheaper}}{\text{Quantity of superior}} = \frac{\text{C.P. superior} - \text{Mean price}}{\text{Mean price} - \text{C.P. of cheaper}}$$

i.e., the two ingredients are to be mixed in the inverse ratio of the differences of their prices and the mean price.

The above rule may be represented schematically as under:

C.P. of a unit of cheaper quality ($c$) | C.P. of unit of superior quality ($d$)

Mean price ($m$)

($d - m$) | ($m - c$)

$$\frac{\text{Quantity of cheaper quality}}{\text{Quantity of superior quality}} = \frac{d-m}{m-c}$$

**Explanation:** Suppose, $x$ Kg of cheaper quality is mixed with $y$ Kg of superior quality.

Price of cheaper ingredient = ₹$cx$

Price of superior ingredient = ₹$dy$

$\therefore$ Price of mixture = ₹$(cx + dy)$

and quantity of mixture = $(x + y)$ Kg.

$$\therefore \quad \text{Price of mixture/Kg} = ₹\left(\frac{cx+dy}{x+y}\right)$$

$$\therefore \quad \frac{cx+dy}{x+y} = m \quad \Rightarrow \quad cx + dy = mx + my$$

$$\Rightarrow \quad dy - my = mx - cx$$

$$\Rightarrow \quad y(d - m) = x(m - c)$$

$$\Rightarrow \quad \frac{x}{y} = \frac{d-m}{m-c}.$$

**Illustration 1:** In what ratio two varieties of tea, one costing ₹27 per Kg and the other costing ₹32 per Kg, should be blended to produce a blended variety of tea worth ₹30 per Kg. How much should be the quantity of second variety of tea, if the first variety is 60 Kg.

**Solution:**

C.P. of 1 Kg of cheaper tea (₹27) | C.P. of 1 Kg of superior tea (₹32)

Mean Price ₹30

₹32 – ₹30 = ₹2 | ₹30 – ₹27 = ₹3

The required ratio of the two varieties of tea is 2:3, i.e.,

$$\frac{\text{Quantity of cheaper tea}}{\text{Quantity of superior tea}} = \frac{2}{3}$$

$$\therefore \quad \text{Quantity of superior tea} = \frac{60 \times 3}{2} = 90 \text{ Kg}$$

Thus, the second variety of tea is 90 Kg.

**Illustration 2:** Sugar at ₹15 per Kg is mixed with sugar at ₹20 per Kg in the ratio 2:3. Find the per Kg price of the mixture.

**Solution:** Let, the mean price of the mixture be ₹$x$

C.P. of 1 Kg of cheaper sugar (₹15)     C.P. of 1 Kg of superior sugar (₹20)

Mean Price ₹$x$

₹20 – ₹$x$     ₹$x$ – ₹15

$$\frac{\text{Quantity of cheaper sugar}}{\text{Quantity of dearer sugar}} = \frac{20-x}{x-15}$$

$$\therefore \quad \frac{20-x}{x-15} = \frac{2}{3}$$

$\Rightarrow$ $60 - 3x = 2x - 30$

$\Rightarrow$ $5x = 90$ or, $x = 18$.

Thus, the per Kg price of the mixture is ₹18.

## SOME USEFUL SHORTCUT METHODS

1. A vessel, full of wine, contains $a$ litres of it of which $b$ litres are withdrawn. The vessel is then filled with water. Next, $b$ litres of the mixture are withdrawn and, again the vessel is filled with water. This process is repeated $n$ times. Then

$$\frac{\text{Wine left in the vessel after } n\text{th operation}}{\text{Original quantity of wine in the vessel}} = \left(\frac{a-b}{a}\right)^n$$

**Explanation**

Amount of wine after the first operation

$$= a - b = \left(1-\frac{b}{a}\right) \times a$$

Ratio of wine and water after the first operation is $(a - b)$: $b$.

$\therefore$ In $b$ litres of mixture withdrawn in the second operation, amount of wine withdrawn

$$= \frac{a-b}{(a-b)+b} \times b = (a-b)\frac{b}{a}$$

$\therefore$ Amount of wine left after the second operation

$$= (a-b) - (a-b) \times \frac{b}{a} = \left(1-\frac{b}{a}\right)^2 a$$

In general, quantity of wine left after $n$th operation

$$= \left(1-\frac{b}{a}\right)^n a$$

$$\therefore \quad \frac{\text{Wine left after } n\text{th operation}}{\text{Original quantity of wine}} = \left(1-\frac{b}{a}\right)^n.$$

**Illustration 3:** A vessel contains 125 litres of wine. 25 litres of wine was taken out of the vessel and replaced by water. Then, 25 litres of mixture was withdrawn and again replaced by water. The operation was repeated for the third time. How much wine is now left in the vessel?

**Solution:** Amount of wine left in the vessel

$$= \left(1-\frac{25}{125}\right)^3 \times 125 = \frac{100\times100\times100\times125}{125\times125\times125} = 64 \text{ litres.}$$

2. There are $n$ vessels of equal size filled with mixtures of liquids $A$ and $B$ in the ratio $a_1{:}b_1{:}a_2, b_2 \ldots, a_n{:}b_n$, respectively. If the contents of all the vessels are poured into a single large vessel, then

$$\frac{\text{Quantity of liquid } A}{\text{Quantity of liquid } B} = \frac{\left(\dfrac{a_1}{a_1+b_1}+\dfrac{a_2}{a_2+b_2}+\cdots+\dfrac{a_n}{a_n+b_n}\right)}{\left(\dfrac{b_1}{a_1+b_1}+\dfrac{b_2}{a_2+b_2}+\cdots+\dfrac{b_n}{a_n+b_n}\right)}$$

**Explanation** Let the capacity of each vessel be $c$ litres.

Amount of liquid $A$ in different vessels

$$= \frac{a_1c}{a_1+b_1}, \frac{a_2c}{a_2+b_2}, \frac{a_3c}{a_3+b_3}, \ldots, \frac{a_nc}{a_n+b_n}$$

Amount of liquid $B$ in different vessels

$$= \frac{b_1c}{a_1+b_1}, \frac{b_2c}{a_2+b_2}, \frac{b_3c}{a_3+b_3}, \ldots \frac{b_nc}{a_n+b_n}$$

So, in the resulting mixture, amount of liquid $A$

$$= \left(\frac{a_1}{a_1+b_1}+\frac{a_2}{a_2+b_2}+\cdots+\frac{a_n}{a_n+b_n}\right)\times c$$

Amount of liquid $B$

$$= \left(\frac{b_1}{a_1+b_1}+\frac{b_2}{a_2+b_2}+\cdots+\frac{b_n}{a_n+b_n}\right)\times c$$

$$\frac{\text{Quantity of liquid } A}{\text{Quantity of liquid } B} = \frac{\left(\dfrac{a_1}{a_1+b_1}+\dfrac{a_2}{a_2+b_2}+\cdots+\dfrac{a_n}{a_n+b_n}\right)}{\left(\dfrac{b_1}{a_1+b_1}+\dfrac{b_2}{a_2+b_2}+\cdots+\dfrac{b_n}{a_n+b_n}\right)}.$$

**Illustration 4:** Three equal glasses are filled with mixture of milk and water. The proportion of milk and water in each glass is as follows: In the first glass as 3:1, in the second glass as 5:3 and in the third as 9:7. The contents of the three glasses are emptied into a single vessel. What is the proportion of milk and water in it?

**Solution:**

$$\frac{\text{Quantity of milk}}{\text{Quantity of water}} = \frac{\frac{3}{3+1}+\frac{5}{5+3}+\frac{9}{9+7}}{\frac{1}{3+1}+\frac{3}{5+3}+\frac{7}{9+7}} = \frac{31/16}{17/16}$$

$= 31:17.$

3. There are $n$ vessels of sizes $c_1, c_2, \cdots, c_n$ filled with mixtures of liquids $A$ and $B$ in the ratio $a_1 : b_1,\ a_2 : b_2,\ \cdots, a_n : b_n$, respectively. If the contents of all the vessels are poured into a single large vessel, then

$$\frac{\text{Quantity of Liquid } A}{\text{Quantity of liquid } B} = \frac{\frac{a_1c_1}{a_1+b_1}+\frac{a_2c_2}{a_2+b_2}+\cdots+\frac{a_nc_n}{a_n+b_n}}{\frac{b_1c_1}{a_1+b_1}+\frac{b_2c_2}{a_2+b_2}+\cdots+\frac{b_nc_n}{a_n+b_n}}$$

**Illustration 5:** Three glasses of sizes 3 litres, 4 litres and 5 litres, contain mixture of milk and water in the ratio 2:3, 3:7 and 4:11, respectively. The contents of all the three glasses are poured into a single vessel. Find out ratio of milk to water in the resulting mixture.

**Solution:** $\frac{\text{Quantity of milk}}{\text{Quantity of water}}$

$$= \frac{\left(\frac{2\times 3}{2+3}+\frac{3\times 4}{3+7}+\frac{4\times 5}{4+11}\right)}{\left(\frac{3\times 3}{2+3}+\frac{7\times 4}{3+7}+\frac{11\times 5}{4+11}\right)}$$

$$= \frac{\frac{6}{5}+\frac{12}{10}+\frac{20}{15}}{\frac{9}{5}+\frac{28}{10}+\frac{55}{15}} = 56.124$$

or, 14:31.

## Exercise-I

**1.** How many Kg of tea, worth ₹25 per Kg, must be blended with 30 Kg of tea worth ₹30 per Kg, so that by selling the blended variety at ₹30 per Kg there should be a gain of 10%?

(a) 36 Kg (b) 40 Kg
(c) 32 Kg (d) 42 Kg

**2.** How much water be added to 14 litres of milk worth ₹5.40 a litre so that the value of the mixture may be ₹4.20 a litre?

(a) 7 litres (b) 6 litres
(c) 5 litres (d) 4 litres

**3.** In what ratio two varieties of tea, one costing ₹25 per Kg and the other costing ₹30 per Kg should be blended to produce blended variety of tea worth ₹28 per Kg?

(a) 3:4 (b) 4:3
(c) 2:3 (d) 3:5

**4.** In an examination out of 80 students 85% of the girls and 70% of the boys passed. How many boys appeared in the examination if total pass percentage was 75%?

(a) 370 (b) 340
(c) 320 (d) 360

**5.** In what proportion must tea worth 75 paise per packet be mixed with tea worth ₹5.50 per packet so that the mixture may cost ₹4.50 per packet?

(a) 3:11 (b) 4:15
(c) 15:11 (d) 4:5

**6.** How many Kg of sugar costing ₹5.50 per Kg must be mixed with 60 Kg of sugar costing ₹4.80 per Kg so that the mixture is worth ₹5.25 per Kg?

(a) 90 Kg (b) 95 Kg
(c) 108 Kg (e) 106 Kg

**7.** How many Kg of sugar costing ₹5.75 per Kg should be mixed with 75 Kg of cheaper sugar costing ₹4.50 per Kg, so that the mixture is worth ₹5.50 per Kg?

(a) 250 Kg (b) 300 Kg
(c) 350 Kg (d) 325 Kg

**8.** In what ratio must water be added to spirit to gain 10% by selling it at the cost price?

(a) 1:11 (b) 1:5
(c) 1:10 (d) 1:9

**9.** 300 gm of salt solution has 40% salt in it. How much salt should be added to make it 50% in the solution?

(a) 40 gm (b) 60 gm
(c) 70 gm (d) 80 gm

**10.** A man buys two cows for ₹1350 and sells one, so as to lose 6%, and the other so as to gain 7.5% and on the whole he neither gains nor loses. What does each cow cost?

(a) 750, 500 (b) 750, 600
(c) 600, 500 (d) 700, 650

**11.** There are 65 students in a class, 39 rupees are distributed among them so that each boy gets 80 Paise and girl gets 30 Paise. Find out the number of boys and girls in that class.

(a) 43, 40 (b) 36, 33
(c) 39, 26 (d) 45, 42

**12.** A trader has 50 Kg of sugar, a part of which he sells at 10% profit and the rest at 5% loss. He gains 7% on the whole. What is the quantity sold at 10% gain and 5% loss?

(a) 40 Kg, 10 Kg (b) 10 Kg, 35 Kg
(c) 25 Kg, 15 Kg (d) 30 Kg, 20 Kg

**13.** A person has ₹5000. He invests a part of it at 3% per annum and the remainder at 8% per annum simple interest. His total income in 3 years is ₹750. Find the sum invested at different rates of interest.

(a) ₹2000, ₹1000 (b) ₹3000, ₹1000
(c) ₹1000, ₹4000 (d) ₹3000, ₹2000

**14.** Some amount out of ₹7000 was lent at 6% p.a. and the remaining at 4% p.a. If the total simple interest from both the fractions in 5 years was ₹1600, the sum lent at 6% p.a. was:

(a) ₹3000 (b) ₹4000
(c) ₹5000 (d) ₹2000

**15.** 729 ml of a mixture contains milk and water in the ratio 7:2. How much more water is to be added to get a new mixture containing milk and water in the ratio 7:3?

(a) 600 ml (b) 710 ml
(c) 520 ml (d) None of these

**16.** In what proportion water must be added to spirit to gain 20% by selling it at the cost price?

(a) 1:5 (b) 2:5
(c) 3:5 (d) 4:5

**17.** The average monthly salary of employees, consisting of officers and workers of an organization is ₹3000. The average salary of an officer is ₹10000 while that of a worker is ₹2000 per month. If there are total 400 employees in the organization, find out the number of officers and workers separately.

(a) 50, 275 (b) 350, 450
(c) 50, 350 (d) 325, 350

**18.** A person covers a distance 100 Kms in 10 hours, partly by walking at 7 Km/h and rest by running at 12 Km/h. Find out the distance covered in each part.

(a) 28 Km, 72 Km (b) 32 Km, 82 Km
(c) 24 Km, 68 Km (d) 26 Km, 70 Km

**19.** The average weekly salary per head of all employees (supervisors and labourers) is ₹100. The average weekly salary per head of all the supervisors is ₹600, while the average weekly salary per head of all the labourers is ₹75. Find out the number of supervisors in the factory if there are 840 labourers in it.

(a) 46 (b) 42
(c) 44 (d) 48

**20.** A person has a chemical of ₹25 per litre. In what ratio should water be mixed in that chemical, so that after selling the mixture at ₹20/litre he may get a profit of 25%?

(a) 13:16 (b) 16:9
(c) 12:15 (d) 19:22

**21.** A person travels 285 Km in 6 hours in two stages. In the first part of the journey, he travels by bus at the speed of 40 Km/h. In the second part of the journey, he travels by train at the speed of 55 Km/h. How much distance did he travel by train?

(a) 205 Km (b) 145 Km
(c) 165 Km (d) 185 Km

**22.** A trader has 50 Kg of pulses, part of which he sells at 8% profit and the rest at 18% profit. He gains 14% on the whole. What is the quantity sold at 18% profit?

(a) 30 Kg (b) 25 Kg
(c) 20 Kg (d) 40 Kg

**23.** A trader has 50 Kg of rice, a part of which he sells at 10% profit and the rest at 5% loss. He gains 7% on the whole. What is the quantity sold at 10% gain and 5% loss?

(a) 30 Kg, 10 Kg (b) 40 Kg, 15 Kg
(c) 35 Kg, 40 Kg (d) 40 Kg, 10 Kg

**24.** Mira's expenditure and savings are in the ratio 3 : 2. Her income increases by 10%. Her expenditure also increases by 12%. By how many % does her saving increase?

(a) 7% (b) 10%
(c) 9% (d) 13%

## EXERCISE-2
## (BASED ON MEMORY)

**1.** 40 litres of mixture of milk and water contains 10% of water. The water to be added to make the water content 20% in the new mixture is:

(a) 6 litres (b) 6.5 litres
(c) 5.5 litres (d) 5 litres

**[SSC (GL) Prel. Examination, 2003]**

**2.** 1 litre of water is added to 5 litres of alcohol–water solution containing 40% alcohol strength. The strength of alcohol in the new solution will be:

(a) 30% (b) 33%
(c) $33\frac{2}{3}\%$ (d) $33\frac{1}{3}\%$

**[SSC (GL) Prel. Examination, 2007]**

**3.** Two types of steel are available. Type A contains 5% of nickel and type B contains 40% of nickel. How much of each type be mixed to obtain 140 tonnes of steel containing 30% of nickel?

(a) 40, 100 tonnes (b) 50, 125 tonnes
(c) 30, 75 tonnes (d) 60, 180 tonnes

**[SSC (GL) Asstt. Grade Main Examination, 2000]**

**4.** Two alloys, A and B, contain silver and copper in the ratio 5:1 and 7:2, respectively. Find the ratio in which they be mixed such that there be 80% of silver.

(a) 3:2 (b) 2:3
(c) 1:3 (d) 3:4

**[SSC Asstt. Grade Main Examination, 1998]**

**5.** In what ratio water should be mixed with a liquid at ₹12 per litre so that by selling the mixture at ₹13.75 per litre, the seller gains 25%?

(a) 1:11 (b) 1:15
(c) 1:17 (d) 1:13

**[SSC Assistant Grade Main Examination, 1992]**

**6.** A tea seller mixes two kinds of tea one at ₹15 Kg and other at ₹20 per Kg. In what ratio should he mix them to get the price of mixture at ₹16.50 per Kg?

(a) 8:3 (b) 5:7
(c) 7:3 (d) 7:5

**[SSC UDC Examination, 1996]**

**7.** A tea producer mixes two categories of tea from two gardens is the ratio 5:3. The cost price of one category is ₹27 per Kg and that of other is ₹30 per Kg. The mixture is sold at ₹30.25 a Kg. Find his gain per cent.

(a) $8\frac{5}{3}$ (b) $7\frac{5}{9}$
(c) $9\frac{5}{9}$ (d) $11\frac{5}{9}$

**[SSC Auditor's Examination, 1994]**

**8.** A jar full of whisky contains 40% of alcohol. A part of this whisky is replaced by another containing 19% alcohol and, now the percentage of alcohol was found to be 26. The quantity of whisky replaced is:

(a) $\frac{2}{5}$ (b) $\frac{1}{3}$
(c) $\frac{2}{3}$ (d) $\frac{3}{5}$

**[Hotel Management Examination, 1991]**

**9.** In a mixture of 60 litres, the ratio of milk and water is 2:1. If the ratio of the milk and water is to be 1:2, then the amount of water to be further added is:

(a) 20 litres (b) 30 litres
(c) 40 litres (d) 60 litres

**[NDA Examination, 1990]**

**10.** A solution of sugar syrup has 15% sugar. Another solution has 5% sugar. How many litres of the second solution must be added to 20 litres of the first solution to make a solution of 10% sugar?

(a) 10 (b) 5
(c) 15 (d) 20

**[LIC AAO Examination, 1988]**

**11.** A part of sum of ₹10000 is lent at 8% and the remaining sum at 10% per annum. If the average rate of interest is 9.2%, then the two parts are:

(a) ₹4000, ₹6000
(b) ₹5500, ₹4500
(c) ₹5000, ₹5000
(d) ₹5500, ₹4500

**[SSC (GL) Prel. Examination, 1993]**

**12.** Zinc and copper are in the ratio of 5:3 in 200 gm of an alloy. How much gm of copper be added to make the ratio of 3:5?

(a) $133\frac{1}{3}$ (b) $\frac{1}{200}$
(c) 72 (d) 66

**[SSC (GL) Prel. Examination, 2002]**

**13.** The wheat sold by a grocer contained 10% low quantity wheat. What quantity of good quality wheat should be added to 150 Kg of wheat so that the percentage of low quality wheat become 5%?

(a) 150 Kg (b) 135 Kg
(c) 50 Kg (d) 85 Kg
(e) None of these

**[SBI Associate Banks PO Examination, 2002]**

**14.** Tea at ₹126 per Kg and at ₹135 per Kg are mixed with a third variety in the ratio 1:1:2.
If the mixture is worth ₹153 per Kg, the price of the third variety per Kg is:

(a) ₹169.50 (b) ₹175.50
(c) ₹175 (d) ₹185

**[SSC CPO (SI) Examination, 2003]**

**15.** A shopkeeper sells milk which contains 5% water. What quantity of pure milk should be added to 2 litres of milk (containing 5% water) so that proportions of water become 4%?

(a) 1 litre (b) 2 litres
(c) 0.5 litre (d) None of these

**[SBI Mumbai Bank PO Examination, 2000]**

**16.** What quantity of water should be added to 3 litres of 10% solution of salt, so that it becomes 5% salt solution?

(a) 1.5 litres (b) 2.7 litres
(c) 3 litres (d) Cannot be determined
(e) None of these

**[ECGC of India Ltd, Bank PO Examination, 2001]**

**17.** A container contains 10 litres mixture in which there is 10% sulphuric acid. How much sulphuric acid is to be added to make the solution to contain 25% sulphuric acid?

(a) 2 litres (b) 1 litre
(c) 4 litres (e) Data inadequate
(e) None of these

**[BSRB Baroda Bank Clerical Examination, 2000]**

**18.** A painter mixes colour paint with white colour so that the mixture contains 10% blue colour. In a mixture of 40 litres colour, how many litres blue colour should be added so that the mixture contains 20% of blue colour?

(a) 2.5 litres (b) 4 litres
(c) 5 litres (d) 2 litres
(e) None of these

**[BSRB Lucknow Bank Clerical Examination, 2000]**

**19.** A mixture of 66 litres of milk and water are in the ratio of 5:1, water is added to make the ratio 3:5. Find the quantity of water added.

(a) 20 litres (b) 18 litres
(c) 22 litres (d) 24 litres

**[LIC AAO Examination, 1998]**

**20.** A petrol pump owner mixed leaded and unleaded petrol in such a way that the mixture contains 10% unleaded petrol. What quantity of leaded petrol should be added to 1 litre mixture, so that the percentage of unleaded petrol becomes 5%?

(a) 1000 ml (b) 900 ml
(c) 1900 ml (d) 1800 ml

**[SBI Associates PO, Examinatin, 1999]**

**21.** Kantilal mixes 80 Kg of sugar worth of ₹6.75 per Kg with 120 Kg worth of ₹8 per Kg. At what rate shall he sell the mixture to gain 20%?

(a) ₹7.50 (b) ₹9
(c) ₹8.20 (d) ₹8.85

**[BSRB Bhopal Examination, 1998]**

**22.** Jaydeep purchased 25 Kg of rice at the rate of ₹16.80 per Kg and 35 Kg of rice at the rate of ₹25.50 per Kg. He mixed the two and sold the mixture. Approximately, at what price per Kg did he sell the mixture to make 25 per cent profit?

(a) ₹26.50 (b) ₹27.50
(c) ₹28.50 (d) ₹30.00

**[BSRB Mumbai PO Examination, 1998]**

**23.** Jagtap purchases 30 Kg of wheat at the rate of ₹11.50 per Kg and 20 Kg of wheat at the rate of ₹14.25 per Kg. He mixed the two and sold the mixture. Approximately at what price per Kg should he sell the mixture to make 30 percent profit?

(a) ₹16.30 (b) ₹18.20
(c) ₹15.60 (d) ₹14.80

**[BSRB Calcutta PO Examination, 1999]**

**24.** Prabha purchased 30 Kg of rice at the rate of ₹17.50 per Kg and another 30 Kg rice at a certain rate. He mixed the two and sold the entire quantity at the rate of ₹18.60 per Kg and made 20 per cent overall profit. At what price per Kg did he purchase the lot of another 30 Kg rice?

(a) ₹14.50 (b) ₹12.50
(c) ₹15.50 (d) ₹13.50

**[BSRB Chennai PO Examination, 2000]**

**25.** A grocer purchased 20 Kg of rice at the rate of ₹15 per Kg and 30 Kg of rice at the rate of 13 per Kg. At what price per Kg should he sell the mixture to earn $33\frac{1}{3}\%$ profit on the cost price?

(a) ₹28.00 (b) ₹20.00
(c) ₹18.40 (d) ₹17.40

**[BSRB Delhi PO Examination, 2000]**

**26.** The ratio of milk and water in mixtures of four containers are 5:3, 2:1, 3:2 and 7:4, respectively. In which container the quantity of milk, relative to water is minimum?

(a) First (b) Second
(c) Third (d) Fourth

**[SSC (GL) Examination, 2010]**

**27.** *A* can contains a mixture of two liquids *A* and *B* in the ratio 7:5. When 9 litres of mixture are drawn of and the can is filled with *B*, the ratio of *A* and *B* becomes 7:9. Litres of liquid *A* contained by the can initially was:

(a) 10 (b) 20
(c) 21 (d) 25

**[SSC (GL) Examination, 2011]**

**28.** In a mixture of milk and water, the proportion of water by weight was 75%. If in the 60 gm mixture, 15 gm water was added, what would be the percentage of water? (Weight in gm)

(a) 75% (b) 88%
(c) 90% (d) None of these

**[IOB PO Examination, 2009]**

**29.** The ratio of the quantities of an acid and water in a mixture is 1:3. If 5 litres of acid is further added to the mixture, the new ratio becomes 1:2. The quantity of new mixture in litres is:

(a) 32 (b) 40
(c) 42 (d) 45

**[SSC (GL) Examination, 2011]**

**30.** An alloy contains copper, zinc and nickel in the ratio of 5:3:2. The quantity of nickel in Kg that must be added to 100 Kg of this alloy to have the new ratio 5:3:3 is:

(a) 8 (b) 10
(c) 12 (d) 15

**[SSC (GL) Examination, 2011]**

**31.** In three vessels, the ratio of water and milk is 6:7, 5:9 and 8:7, respectively. If the mixture of the three vessels is mixed, then what will be the ratio of water and milk?

(a) 2431:3781 (b) 3691:4499
(c) 4381:5469 (d) None of these

**[UPPCS Examination, 2012]**

**32.** 20 litres of a mixture contains 20% alcohol and the rest is water. If 4 litres of water be mixed in it, the percentage of alcohol in the new mixture will be:

(a) $33\frac{1}{3}\%$ (b) $16\frac{2}{3}\%$

(c) 25% (d) $12\frac{1}{2}\%$

**[SSC Examination, 2014]**

**33.** There are two containers of equal capacity. The ratio of milk to water in the first container is 3:1, in the second container 5:2. If they are mixed up, the ratio of milk to water in the mixture will be:

(a) 28:41 (b) 41:28
(c) 15:41 (d) 41:15

**[SSC Examination, 2014]**

**34.** Sourav purchased 30 Kg of rice at the rate of ₹10 per Kg and 35 Kg at the rate of ₹11 per Kg. He mixed the two. At what price per Kg should he sell the mixture to make a 30% profit in the transaction?

(a) 12.5 (b) 13
(c) 13.7 (d) 14.25

**[SSC Examination, 2013]**

**35.** The ratio of alcohol and water in 40 litres of mixture is 5:3. Then 8 litres of the mixture is removed and replaced with water. Now, the ratio of the alcohol and water in the resultant mixture is:

(a) 1:2 (b) 1:1
(c) 2:1 (d) 1:3

**[SSC Assistant Grade III Examination, 2012]**

**36.** Two vessels contain milk and water in the ratio 3:2 and 7:3. Find the ratio in which the contents of the two vessels have to be mixed to get a new mixture in which the ratio of milk and water is 2:1.

(a) 2:1 (b) 1:2
(c) 4:1 (d) 1:4

**[SSC Examination, 2012]**

**37.** A mixture contains 80% acid and rest water. Part of the mixture that should be removed and replaced by same amount of water to make the ratio of acid and water 4:3 is:

(a) $\frac{1}{3}$rd (b) $\frac{3}{7}$th

(c) $\frac{2}{3}$rd (d) $\frac{2}{7}$th

**[SSC Examination, 2011]**

**38.** A and B are two alloys of gold and copper prepared by mixing metals in the ratio 7:2 and 7:11 respectively. If equal quantities of the alloys are melted to form a third alloy C, the ratio of gold and copper in C will be:

(a) 5:7 (b) 5:9
(c) 7:5 (d) 9:5

**[SSC Examination, 2011]**

**39.** In a laboratory, two bottles contain mixture of acid and water in the ratio 2:5 in the first bottle and 7:3 in the second. The ratio in which the contents of these two bottles be mixed such that the new mixture has acid and water in the ratio 2:3 is:

(a) 4:15 (b) 9:8
(c) 21:8 (d) 1:2

**[SSC Examination, 2011]**

**40.** There are two vessels A and B. Vessel A is containing 40 litres of pure milk and vessel B is containing 22 litres of pure water. From vessel A, 8 litres of milk is taken out and poured into vessel B. Then 6 litres of mixture (milk and water) is taken out and from vessel B poured into vessel A. What is the ratio of the quantity of pure milk in vessel A to the quantity of pure water in vessel B?

(a) 14:9 (b) 21:11
(c) 24:13 (d) 14:5
(e) 21:13

**[IBPS PO/MT Examination, 2014]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (d) | **3.** (c) | **4.** (c) | **5.** (b) | **6.** (c) | **7.** (b) | **8.** (c) | **9.** (b) | **10.** (b) | **11.** (c) | **12.** (a) | **13.** (d) |
| **14.** (d) | **15.** (d) | **16.** (a) | **17.** (c) | **18.** (a) | **19.** (b) | **20.** (b) | **21.** (c) | **22.** (a) | **23.** (d) | **24.** (a) | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (d) | **2.** (d) | **3.** (a) | **4.** (b) | **5.** (a) | **6.** (c) | **7.** (b) | **8.** (c) | **9.** (d) | **10.** (d) | **11.** (a) | **12.** (a) | **13.** (a) |
| **14.** (b) | **15.** (c) | **16.** (c) | **17.** (a) | **18.** (c) | **19.** (c) | **20.** (a) | **21.** (b) | **22.** (a) | **23.** (a) | **24.** (d) | **25.** (c) | **26.** (c) |
| **27.** (c) | **28.** (d) | **29.** (d) | **30.** (b) | **31.** (b) | **32.** (b) | **33.** (d) | **34.** (c) | **35.** (b) | **36.** (b) | **37.** (d) | **38.** (c) | **39.** (c) |
| **40.** (b) | | | | | | | | | | | | |

# EXPLANATORY ANSWERS

## EXERCISE-I

**1. (a)** S.P. = ₹30 per Kg

Gain = 10 %

$$\text{C.P.} = ₹\,\frac{30\times100}{110} = ₹\,\frac{300}{11}$$

The required ratio of the two varieties of tea

$$= \frac{30}{11} : \frac{25}{11} = 6:5$$

$$\frac{\text{Quantity of cheaper tea}}{\text{Quantity of superior tea}} = \frac{6}{5}$$

C.P. of 1 Kg of cheaper tea (₹25) | C.P. of 1 Kg of superior tea (₹30)

Mean Price $₹\frac{300}{11}$

$₹30 - ₹\frac{300}{11} = ₹\frac{30}{11}$ | $₹\frac{300}{11} - ₹25 = ₹\frac{25}{11}$

Quantity of cheaper tea $= \frac{6}{5} \times 30 = 36$ Kg.

**2. (d)** Water 0 | Milk 540

420

120 : 420

2 : 7

Water is free, its cost can be taken as 0 paisa per litre. By method of alligation the ratio of water and milk is 2:7, i.e., with 7 litres of milk, 2 litres of water is added, with 14 litres, water added is 4 litres.

**3. (c)** C.P. of 1 Kg of cheaper tea (₹25) | C.P. of 1 Kg of superior tea (₹30)

Mean Price ₹28

₹30 – ₹28 = ₹2 | ₹28 – ₹25 = ₹3

∴ The required ratio of two varieties of tea is 2:3.

**4. (c)** Pass % of boys (70%) | Pass % of girls (85%)

Average 75%

10 | 5

By Alligation rule:

$$\frac{\text{Number of boys}}{\text{Number of girls}} = \frac{10}{5} = \frac{2}{1}$$

Total number of students = 480

$$\text{Number of boys} = \frac{480\times2}{3} = 320.$$

**5. (b)** By method of alligation the required ratio is 4:15.

75 *P* | 550 *P*

450 *P*

550 – 450 : 450 – 75

100 : 375

4 : 15

**6. (c)** 4.80 | 5.50

5.25

₹(5.50 – 5.25) = ₹0.25 | ₹(5.25 – 4.80) = ₹0.45

$$\text{Now, } \frac{.25}{.45} = \frac{5}{9}$$

$$\therefore \frac{5}{9} = \frac{60}{\text{superior sugar}}$$

$$\therefore \text{Quantity of superior sugar} = \frac{60\times9}{5} = 108 \text{ Kg.}$$

**7.** **(b)**

| C.P. of 1 Kg of cheaper sugar (₹4.50) | | C.P. of 1 Kg of superior sugar (₹5.75) |
|---|---|---|
| | Mean Price (₹5.50) | |
| ₹5.75 – ₹5.50 = ₹0.25 | | ₹5.50 – ₹4.50 = ₹1.00 |

Quantity of cheaper sugar:Quantity of superior sugar = 0.25:1

or, $\dfrac{\text{Quantity of cheaper sugar}}{\text{Quantity of superior sugar}} = \dfrac{0.25}{1} = \dfrac{1}{4}$

$\Rightarrow \quad \dfrac{75}{\text{Quantity of dearer sugar}} = \dfrac{1}{4}$

$\therefore$ Quantity of dearer sugar = 75 × 4 = 300 Kg.

**8.** **(c)** Let the C.P. of spirit = ₹10 per litre

S.P. of the mixture = ₹10 per litre

Profit = 10%

$\therefore$ C.P. of the mixture $= \dfrac{10 \times 100}{110}$

$= ₹\,\dfrac{100}{11}$ per litre

| C.P. of water per litre ₹0 | | C.P. of pure spirit per litre (₹10) |
|---|---|---|
| | Mean Price ₹$\frac{100}{11}$ | |
| ₹10 – ₹$\frac{100}{11}$ = ₹$\frac{10}{11}$ | | ₹$\frac{100}{11}$ – 0 = ₹$\frac{100}{11}$ |

$\therefore \quad \dfrac{\text{Quantity of water}}{\text{Quantity of spirit}} = \dfrac{10/11}{100/11} = 1:10.$

**9.** **(b)** The existing solution has 40% salt. More salt is to be mixed to make 100% salt solution. So, by alligation method:

| 40% | | 100% |
|---|---|---|
| | 50% | |
| 50% | | 10% |

$\therefore$ The two mixtures should be added in the ratio 5:1.

$\therefore$ Required salt $= \dfrac{300}{5} \times 1 = 60$ gm.

**10.** **(b)**

| 1st cow –6% | | 2nd cow 7.5% |
|---|---|---|
| | 0 | |
| 7.5 | | 6 |

Thus, we see that the ratio of the cost of two cows is 5:4.

$\therefore$ Cost of 1st cow $= \dfrac{1350}{5+4} \times 5 =$ ₹750

and, cost of 2nd cow $= \dfrac{1350}{5+4} \times 4 =$ ₹600.

**11.** **(c)** Here, alligation is applicable for 'money per boy or girl'.

Mean value of money per student $= \dfrac{65}{3+2} = 60P.$

| Boys 80 | | Girls 30 |
|---|---|---|
| | 60 | |
| 30 | | 20 |

$\therefore$ Boys:Girl = 3:2.

$\therefore$ Number of boys $= \dfrac{65}{3+2} \times 3 = 39.$

number of girls = 65 – 39 = 26.

**12.** **(a)**

| I part 10 | | II part (–) 5 |
|---|---|---|
| | 7 | |
| 12 | | 3 |

$\therefore$ Ratio of quantities sold at 10% profit and 5% loss = 12:3 = 4:1

$\therefore$ The quantity sold at 10% profit $= \dfrac{50}{4+1} \times 4$

= 40 Kg

and, the quantity sold at 5% loss = 50 – 40 = 10 Kg.

**13.** **(d)** Average rate of interest

$= \dfrac{100 \times 750}{5000 \times 3} = 5\%$ per annum

$$\begin{array}{ccc} 3 & & 8 \\ & 5 & \\ 3 & & 2 \end{array}$$

Investment at 3% per annum

$= \dfrac{3}{3+2} \times 5000 = ₹3000$

Investment at 8% per annum

$= \dfrac{2}{3+2} \times 5000 = ₹2000.$

**14.** **(d)** Overall rate of interest $= \dfrac{1600 \times 100}{5 \times 7000} = \dfrac{32}{7}\%$

$$\begin{array}{ccc} \text{Rate for I amount} & & \text{Rate for II amount} \\ 6\% & & 4\% \\ & \dfrac{32}{7}\% & \\ & \text{(Average rate)} & \\ \dfrac{4}{7}\% & & \dfrac{10}{7}\% \end{array}$$

$\therefore$ Ratio of two amounts = 2:5.

$\therefore$ Amount lent at 6% $= \dfrac{2}{7} \times 7000 = ₹2000.$

**15.** **(d)** Milk $= \left(729 \times \dfrac{7}{9}\right) = 567$ ml

Water = 729 – 567 = 162 ml

Now, $\dfrac{567}{162 + x} = \dfrac{7}{3} \Rightarrow x = 81$ ml.

**16.** **(a)** Let, the C.P. of the spirit = ₹10 per litre.

S.P. of the mixture = ₹10 per litre.

Profit = 20%

$\therefore$ C.P. of the mixture $= ₹\dfrac{10 \times 100}{120}$

$= ₹\dfrac{25}{3}$ per litre

$$\begin{array}{ccc} \text{C.P. of water per litre} & & \text{C.P. of pure spirit} \\ (₹0) & & \text{per litre } (₹10) \\ & \text{(Average rate)} & \\ & ₹\dfrac{25}{3} & \\ ₹10 - ₹\dfrac{25}{3} & & ₹\dfrac{25}{3} - ₹0 \\ ₹\dfrac{5}{3} & & ₹\dfrac{25}{3} \end{array}$$

$\dfrac{\text{Quantity of water}}{\text{Quantity of spirit}} = \dfrac{5/3}{25/3} = \dfrac{1}{5}$

Ratio of water and spirit = 1:5.

**17.** **(c)**

$$\begin{array}{ccc} ₹10000 & & ₹2000 \\ & ₹3000 & \\ 1000 & & 7000 \end{array}$$

$\dfrac{\text{Number of officers}}{\text{Number of workers}} = \dfrac{1000}{7000} = \dfrac{1}{7}.$

Number of officers $= \dfrac{1}{1+7} \times 400 = 50.$

Numbers of worker = 400 – 50 = 350.

**18.** **(a)** Average speed $= \dfrac{100}{10} = 10$ Km/h

$$\begin{array}{ccc} 7 & & 12 \\ & 10 & \\ 2 & & 3 \end{array}$$

Ratio of time taken at 7 Km/h to 12 Km/h = 2:3.

Time taken at 7 Km/h

$= \dfrac{2}{2+3} \times 10 = 4$ hours.

Distance covered at 7 Km/h

= 7 × 4 = 28 Km.

Distance covered at 12 Km/h

= 100 – 28 = 72 Km.

**19.** **(b)**

$$\begin{array}{ccc} \text{Average salary of} & & \text{Average salary of} \\ \text{labourers } (₹75) & & \text{supervisors } (₹600) \\ & \text{Mean salary of all} & \\ & \text{the staff } (₹100) & \\ 500 & & 25 \end{array}$$

The required ratio is 500:25, or 20:1

$\dfrac{\text{Number of labourers}}{\text{Number of supervisors}} = \dfrac{20}{1}$

$\Rightarrow \dfrac{840}{\text{Number of supervisors}} = \dfrac{20}{1}$

$\therefore$ Number of supervisors $= \dfrac{840}{20} = 42.$

**20.** **(b)** In this question, the alligation method is applicable on prices, so we should get the average price of mixture.

S.P. of mixture = ₹20/litre, profit = 25%.

$\therefore$ Average price = $20 \times \frac{100}{125}$ = ₹16/litre

Chemical 25 — Water 0

16

16 — 9

$\therefore$ Chemical:water = 16:9.

**21.** **(c)** In this question, the alligation method is applicable for the speed.

Speed of bus 40 — Speed of train 55

Average speed $\frac{285}{6}$

$\frac{45}{6}$ — $\frac{45}{6}$

$\therefore$ Time spent in bus:time spent in train

$= \frac{45}{6} : \frac{45}{6} = 1:1.$

$\therefore$ Distance travelled by train = $55 \times 3 = 165$ Km.

**22.** **(a)**

I part 8% profit — 2nd part 18% profit

14% (mean profit)

4% — 6%

$\therefore$ Ratio of quantities sold at 8% profit and 18% profit = 4:6 = 2:3

Therefore, the quantity sold at 18% profit

$= \frac{50}{2+3} \times 3 = 30$ Kg.

**23.** **(d)**

I part 10 — II part (–) 5

7

12 — 3

$\therefore$ Ratio of quantities sold at 10% profit and 5% loss = 12:3 = 4:1

$\therefore$ The quantity sold at 10% profit

$= \frac{50}{4+1} \times 4 = 40$ Kg

and, the quantity sold at 5% loss = 50 – 40 = 10 Kg.

**24.** **(a)**

Expenditure 12 (% increase in exp.) — Saving $x$ (% increase in saving)

10 (% increase in income)

3 — 2 (given)

We get two values of $x$, 7 and 13. But, to get a viable answer, we must keep in mind that the central value (10) must lie between $x$ and 12. Thus, the value of $x$ should be 7 and not 13.

$\therefore$ Required % increase = 7%.

## Exercise-2
## (Based on Memory)

**1. (d)** Amount of milk and water in the mixture is 36 litres and 4 litres, respectively.

Now, let $x$ litres of water be added

20% of $(40 + x) = 4 + x$

or, $40 + x = 20 + 5x$

or, $4x = 20$ or, $x = 5$ litres

**3. (a)** Nickel in Type A = 5%

Nickel in Type B = 40%

Nickel in resulting steel = 30%.

By Alligation rule

Type A:Type B = 10:25 = 2:5

We have to obtain 140 tonnes of steel

Type A 5% | Type B 40%

30%

10% | 25%

$\therefore$ Steel of type A = $\frac{2}{7} \times 140 = 40$ tonnes

Steel of type B = $\frac{5}{7} \times 140 = 100$ tonnes.

**4. (b)** Resulting alloy has 80% of silver and hence, 20% of copper.

$\therefore$ Silver:Copper = 80:20 = 4:1.

By Alligation rule,

Type A $\frac{5}{6}$ | Type B $\frac{7}{9}$

$\frac{4}{5}$

$\frac{4}{5} - \frac{7}{9} = \frac{36-35}{45} = \frac{1}{45}$ | $\frac{5}{6} - \frac{4}{5} = \frac{25-24}{30} = \frac{1}{30}$

$\therefore$ Required ratio = $\frac{1}{45} : \frac{1}{30}$

i.e., Type A:Type B = $\frac{1}{3} : \frac{1}{2}$ = 2:3.

**5. (a)** Gain = 25%, S.P. = ₹13.75 per litre

$\therefore$ C.P. of mixture = $\frac{100 \times 13.75}{100 + 25}$ = ₹11 per litre

C.P. of 1 litre of water ₹0 | C.P. of 1 litre of liquid ₹12

Mean price ₹11

₹(12 – 11) = ₹1 | ₹(11 – 0) = ₹11

C.P. of water may be assumed as ₹0 per litre

C.P.of liquid = ₹12 per litre

By the rule of alligation, we have

$\therefore$ Water:Liquid = 1:11.

**6. (c)** By Alligation Rule

Kind I C.P. of 1 Kg ₹15 | Kind II C.P. of 1 Kg ₹20

Mean price ₹16.50

₹3.50 | ₹1.50

$\therefore$ Kind I:Kind II = 3.5:1.5 = 7:3.

**7. (b)** Given ratio = 5:3

If the tea producer mixed $5x$ Kg of the category of tea to that of $3x$ Kg of the second category of tea.

C.P. of category I tea = ₹27 per Kg

C.P. of $5x$ Kg tea = $5x \times 27$ = ₹$135x$

C.P. of category II tea = ₹30 per Kg

$\therefore$ C.P. of $3x$ Kg tea = $3x \times 30$ = ₹$90x$

Total mixture = $5x + 3x = 8x$ Kg

Total cost price = $135x + 90x$ = ₹$225x$

Selling price of 1 Kg of mixture = ₹30.25

Total S.P. = $8x \times 30.25$ = ₹$242x$

Gain = ₹$(242x - 225x)$ = ₹$17x$

Gain % = $\frac{17x}{225x} \times 100 = \frac{68}{9} = 7\frac{5}{9}$%.

**8.** **(c)** Ratio of alcohol to whisky in the jar = 40:60 = 2:3.
Ratio of alcohol to whisky in the new mixture
= 26:74 = 13:37
Now, applying the given alligation method, we have

$\frac{2}{5}$ $\qquad$ $\frac{19}{100}$

$\frac{13}{50}$

$\frac{7}{100}$ $\qquad$ $\frac{7}{50}$

∴ Ratio of alcohol to whisky in the replaced mixture

$$= \frac{7}{100} : \frac{7}{50} = 1:2$$

∴ Quantity of whisky replaced = $\frac{2}{1+2} = \frac{2}{3}$.

**9.** **(d)** $60\left[\dfrac{\frac{200}{3} - \frac{100}{3}}{100 - \frac{200}{3}}\right] = 60$ litres.

**10.** **(d)** $\frac{0.8}{2} = 10$

∴ $m = 20$ litres.

**11.** **(a)** By the rule of alligation

8% $\qquad$ 10%

9.2%

0.8% $\qquad$ 1.2%

∴ First part = $\frac{0.8}{2} \times 1000$ = ₹4000

Second part = (10000 − 4000) = ₹6000.

**12.** **(a)** Weight of zinc = $200 \times \frac{5}{8} = 125$ gm

Weight of copper = $200 \times \frac{3}{8} = 75$ gm
Let the ratio of 125 gm zinc and $x$ gm copper be 3:5

∴ $\frac{125}{x} = \frac{3}{5}$ ∴ $x = \frac{125 \times 5}{3} = \frac{625}{3}$ gm

∴ Addition of copper in mixture

$$\frac{625}{3} - 75 = \frac{625 - 225}{3} = \frac{400}{3} = 133\frac{1}{3} \text{ gm.}$$

**13.** **(a)** Good quality content in 150 Kg of wheat = 90% of 150 = 135 Kg

∴ 5% of the new mixture = 15 Kg

∴ New mixture = $\frac{15 \times 100}{5} = 300$ Kg

∴ Good quality of wheat added = (300 − 150) Kg
= 150 Kg.

**14.** **(b)** Let, the price of the third variety be ₹$x$ per Kg

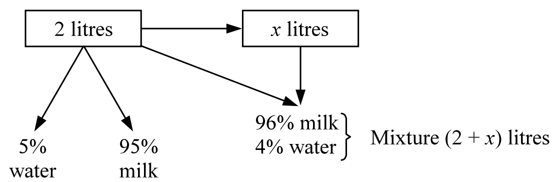
∴ $126 \times 1 + 135 \times 1 + 2 \times x = 153 \times 4$

or, $261 + 2x = 612$ or, $2x = 612 - 261 = 351$

∴ $x = \frac{351}{2} = 175.50$

∴ The required price = ₹175.50 per Kg.

**15.** **(c)**




∴ $\frac{95}{100} + 2 + x = \frac{96}{100}(2 + x)$

or, $190 + 100x = 192 + 96x$ or, $4x = 2$

or, $x = 0.5$ litres.

**16.** **(c)** The given solution has 10% salt. Water which is to be added has 0% salt concentration.

Original Solution 10% $\qquad$ Water 0%

5% (mixture)

5 $\qquad$ 5

Final concentration of solution is 5%.
Salt concentration:
So, water should be added to the given solution in the ratio 5:5 = 1:1.

∴ Quantity of water to be added = $\frac{1}{1} \times 3 = 3$ litres.

**18.** **(c)** Quantity of blue paint in the mixture = 10% of 40 = 4 litres
Quantity of white paint in the mixture
= 40 − 4 = 36 litres
Let, $x$ litres blue paint be added
∴ According to the question, in the final mixture

$$\frac{\text{Quantity of blue paint}}{\text{Quantity of white paint}} = \frac{4+x}{36} = \frac{20}{80}$$

$4 + x = \frac{20 \times 36}{80}$ $\quad\therefore\quad x = 9 - 4 = 5$ litres.

**20. (a)** Here, we have to find out the quantity of leaded petrol. Hence, we have to make certain changes in the given data.

% of leaded petrol in the mixture = 100 – 10 = 90%.

After addition of leaded petrol (that has to be calculated), percentage of leaded petrol becomes (100 – 5) = 95%.

The required answer $= \left(\frac{95 - 90}{100 - 95}\right)$ 1000 ml = 1000 ml.

**21. (b)** $120\left[\frac{100Z - 8(100+20)}{675(100+20) - 100Z}\right] = 80 \;\therefore\; Z =$ ₹9 per Kg.

**22. (a)** $35\left[\frac{100Z - 24.50(100+25)}{16.50(100+25) - 100Z}\right] = 25$

or, $\frac{100Z - 3062.5}{2062.5 - 100Z} = \frac{5}{7}$

or, $700Z - 21437.5 = 10312 - 500Z$

or, $1200Z = 31750$

$\therefore$ $Z =$ ₹26.458 per Kg ≈ Rs.26.50 per Kg.

**23. (a)** $203\left[\frac{100Z - 14.25(100+30)}{11.50(100+30) - 100Z}\right] = 30$

or, $\frac{100Z - 1852.3}{1495 - 100Z} = \frac{3}{2}$ or, $500Z = 8190$

$\therefore$ $Z = \frac{8190}{500} =$ ₹16.38 ≈ ₹16.30.

**24. (d)** $30\left[\frac{100\text{x } 18.60 - y \times 120}{17.50\text{x } 120 - 100 \times 18.60}\right] = 30$

or, $1860 - 120y = 2100 - 1860 = 240$

or, $120y = 1620$ $\quad\therefore\quad y = \frac{1620}{120} =$ ₹13.50.

**25. (c)** $\left[\frac{100 \times Z - 13\left(100 + \frac{100}{3}\right)}{15 \times \left(100\frac{100}{3}\right) - 100Z}\right] \times 30 = 20$

$\therefore$ $Z =$ ₹18.40.

**26. (c)** Milk in the first vessel

$$= \frac{5}{8} = 0.625$$

Milk in the second vessel

$$= \frac{2}{3} = 0.66$$

Milk in the third vessel

$$= \frac{3}{5} = 0.6$$

Milk in the fourth vessel

$$= \frac{7}{11} = 0.636$$

**27. (c)** Let, the quantity initially of liquid $A$ be $7x$ litre.

$\therefore$ Let, the quantity initially of liquid $B$ be $5x$ litre.

Quantity of $A$ after 9 litres mixture drawn

$= 7x - \frac{21}{4} = \frac{28x - 21}{4}$ litres

Quantity of $B$ after 9 litres mixture drawn and adding 9 litres of $B = 5x + \frac{21}{4} = \frac{20x + 21}{4}$

$\therefore$ $\frac{(28x - 21)}{4} : \frac{20x + 21}{4} = \frac{7}{9}$

$\Rightarrow$ $(252 - 140)x = 189 + 147$

$\Rightarrow$ $x = \frac{336}{112} = 3$

The required quantity of $A = 7x = 21$ litres.

**28. (d)** Weight of water in the mixture of 60 g water

$$= 60 \times \frac{75}{100} = 45 \text{ g}$$

Weight of water in the mixture of 45 g water

$$= 45 + 15 = 60 \text{ g}$$

$\therefore$ Percentage of water $= \frac{60 \times 100}{75} = 80\%$

**29. (d)** Let, the quantity of acid in the original mixture be $x$ litre and quantity of water in the original mixture be $3x$ litre.

Therefore, $\frac{x + 5}{3x} = -$

$2(x + 5) = 3x$

$\Rightarrow$ $2x + 10 = 3x$

$\Rightarrow$ $3x - 2x = 10$

$\Rightarrow$ $x = 10$

Therefore, quantity of new mixture

$$= 4x + 5 = 4(10) + 5$$
$$= 45 \text{ litres}$$

**30. (b)** Let, the quantity of nickel mixel be $x$ Kg

Therefore,

$$\frac{20 + x}{100 + x} = \frac{3}{11}$$

$\Rightarrow$ $11(20 + x) = 3(100 + x)$

$\Rightarrow$ $220 + 11x = 300 + 3x$

$\Rightarrow$ $11x - 3x = 300 - 220$

$\Rightarrow$ $8x = 80$

$\Rightarrow$ $x = \frac{80}{8} = 10$ Kg

**31. (b)** Quantity of milk in the mixture

$$= \frac{6}{13} + \frac{5}{14} + \frac{8}{15}$$

$$= \frac{1260 + 975 + 1456}{2730}$$

$$= \frac{3691}{2730}$$

Quantity of milk in the mixture

$$= \frac{7}{13} + \frac{9}{14} \times \frac{7}{15}$$

$$= \frac{1470 + 1755 + 1274}{2730}$$

$$= \frac{4499}{2730}$$

$\therefore$ The required ratio = 3691:4499.

**32.** **(b)** In 20 litres of mixture,

$$\text{Alcohol} = \frac{20 \times 20}{100} = 4 \text{ litres}$$

Water = 20 – 4 = 16 litres

On adding 4 litres of water,

Quantity of water = 16 + 4 = 20 litres

Quantity of mixture = 24 litres

Required per cent

$$= \frac{4}{24} \times 100 = \frac{50}{3} = 16\frac{2}{3}\%$$

**33.** **(d)** Let the capacity of each container be $x$ litres.

In first container,

$$\text{Milk} = \frac{3x}{4} \text{ litres}$$

$$\text{Water} = \frac{x}{4} \text{ litres}$$

In second container

$$\text{Milk} = \frac{5x}{7} \text{ litres}$$

$$\text{Water} = \frac{2x}{7} \text{ litres}$$

On mixing both, we have,

$$\text{Quantity of milk} = \frac{3x}{4} + \frac{5x}{7}$$

$$= \frac{21x + 20x}{28} = \frac{41x}{7} \text{ litres}$$

$$\text{Quantity of water} = \frac{x}{4} + \frac{2x}{7} = \frac{7x + 8x}{28} \text{ litres}$$

$$= \frac{15x}{28} \text{ litres}$$

$$\therefore \text{ Required ratio} = \frac{41x}{28} : \frac{15x}{28} = 41:15$$

**34.** **(c)** Total cost = ₹(3 × 10 + 35 × 11)

= ₹(300 + 385) = ₹685

$$\text{Required S.P.} = ₹\left(\frac{685 \times 130}{100}\right)$$

$$\text{Rate per Kg} = \frac{685 \times 130}{65 \times 100} = ₹13.7$$

**35.** **(b)** In 32 litres of mixture

$$\text{Alcohol} = \left(\frac{5}{8} \times 32\right) = 20 \text{ litres}$$

$$\text{Water} = \left(\frac{3}{8} \times 32\right) = 12 \text{ litres}$$

$\therefore$ Required ratio = 20:20 = 1:1

**36.** **(b)** Let the ratio of contents (milk and water) of two vessels be $x$:$y$

$$\text{Amount of milk in first vessel} = \frac{3x}{5}$$

$$\text{Amount of water in first vessel} = \frac{2x}{5}$$

$$\text{Amount of milk in second vessel} = \frac{7y}{10}$$

$$\text{Amount of water in second vessel} = \frac{3y}{10}$$

Now, according to the question,

$$\frac{3x}{5} + \frac{7y}{10} : \frac{2x}{5} + \frac{3y}{10} = 2:1$$

$$\Rightarrow \frac{3x}{5} = \frac{7y}{10} = 2 \times \left(\frac{2x}{5} + \frac{3y}{10}\right)$$

$\Rightarrow$ $6x + 7y = 8x + 6y$

$\Rightarrow$ $2x = y$

$$\Rightarrow \frac{x}{y} = \frac{1}{2}$$

Therefore, required ratio = 1:2

By Method of Alligation:

Milk-I Milk-II

$\frac{3}{5}$ $\frac{7}{10}$

$\frac{2}{3}$

$\frac{7}{10} - \frac{2}{3}$ $\frac{3}{5} - \frac{2}{3}$

$$= \frac{21 - 20}{30} = \frac{10 - 9}{15}$$

$$= \frac{1}{30} = \frac{1}{15}$$

$$\therefore \text{ Required ratio} = \frac{1}{30} : \frac{1}{15} = 1:2$$

**37.** **(d)** In the beginning, Acid:Water = 4:1

Let $x$ part of mixture be replaced by $x$ part of water.

$\therefore$ In $x$ part of mixture, milk $= \frac{4x}{5}$ part and, water $= \frac{x}{5}$ part

Now, according to the question,

$$\frac{4-\frac{4x}{5}}{1-\frac{x}{5}+x}=\frac{4}{3}$$

$$\Rightarrow \quad \frac{20-4x}{5-x+5x}=\frac{4}{3}$$

$$\Rightarrow \quad 60-12x=20+16x$$

$$\Rightarrow \quad 28x=40$$

$$\Rightarrow \quad x=\frac{40}{28}=\frac{10}{7}=\frac{2}{7}$$

**38.** **(c)** Let the weight of alloy A be 1 Kg.

$\therefore$ Gold in $A=\frac{7}{9}$ Kg and copper $=\frac{2}{9}$ Kg.

In 1 Kg of alloy B, Gold $=\frac{7}{18}$ Kg and copper $=\frac{11}{18}$ Kg.

$\therefore$ Required ratio $=\left(\frac{7}{9}+\frac{7}{18}\right):\left(\frac{2}{9}+\frac{11}{18}\right)$

$$=\frac{21}{18}:\frac{15}{18}=21:15=7:5$$

**39.** **(c)** Let the required ratio be $x:y$

Now, according to the question,

$$\frac{\frac{2x}{7}+\frac{7y}{10}}{\frac{5x}{7}+\frac{3y}{10}}=\frac{2}{3}$$

$$\Rightarrow \quad \frac{20x+49y}{50x+21y}=\frac{2}{3}$$

$$\Rightarrow \quad 60x+147y=100x+42y$$

$$\Rightarrow \quad 100x-60x=147y-42y$$

$$\Rightarrow \quad 40x=105y$$

$$\Rightarrow \quad \frac{x}{y}=\frac{105}{40}=\frac{21}{8}$$

**40.** **(b)** Initially

Milk in Vessel A = 40 litres

Water in Vessel B = 22 litres

After first operation:

Milk in Vessel A = 40 − 8 = 32 litres

Water in Vessel B = 22 litres

Milk in Vessel B = 8 litres

Mixture in Vessel B = 22 + 8 = 30 litres

After second operation (when 6 litres or $\frac{6}{30}=\frac{1}{5}$ of the mixture is taken out from B, it means $\frac{22}{5}$ litres of water and $\frac{8}{5}$ litres of milk is taken out):

Milk in Vessel $A=32+\frac{8}{5}=\frac{168}{5}$ litres

Water in Vessel $B=22-\frac{22}{5}=\frac{88}{5}$ litres

$\therefore$ Required ratio $=\frac{168}{5}:\frac{88}{5}=21:11$

# Problems on Ages

# 16

## INTRODUCTION

Problems based on ages are generally asked in most of the competitive examinations. To solve these problems, the knowledge of linear equations is essential. In such problems, there may be three situations:

(i) Age some years ago
(ii) Present age
(iii) Age some years hence

Two of these situations are given and it is required to find the third. The relation between the age of two persons may also be given. Simple linear equations are framed and their solutions are obtained. Sometimes, short cut methods given below are also helpful in solving such problems.

## SOME USEFUL SHORTCUT METHODS

1. If the age of A, $t$ years ago, was $n$ times the age of B and at present A's age is $n_2$ times that of B, then

A's present age $= \left(\dfrac{n_1 - 1}{n_1 - n_2}\right) n_2 t$ years

and, B's present age $= \left(\dfrac{n_1 - 1}{n_1 - n_2}\right) t$ years

**Explanation**

Let the present age of B be $x$ years.

Then, the present age of A = $n_2 x$ years

Given, $t$ years ago,

$$n_1(x - t) = n_2 x - t \text{ or, } (n_1 - n_2)x = (n_1 - 1)t$$

or, $$x = \left(\frac{n_1 - 1}{n_1 - n_2}\right) t.$$

Therefore, B's present age = . $\left(\dfrac{n_1 - 1}{n_1 - n_2}\right) t$ years

and, A's present age $= \left(\dfrac{n_1 - 1}{n_1 - n_2}\right) n_2 t$ years.

**Illustration 1:** The age of father is 4 times the age of his son. If 5 years ago father's age was 7 times the age of his son at that time, then what is father's present age?

**Solution:** The father's present age

$$= \left(\frac{n_1 - 1}{n_1 - n_2}\right) n_2 t \text{ [Here, } n_1 = 7,\ n_2 = 4 \text{ and } t = 5]$$

$$= \left(\frac{7 - 1}{7 - 4}\right) 4 \times 5 = \frac{6 \times 4 \times 5}{3} = 40 \text{ years.}$$

2. The present age of A is $n_1$ times the present age of B. If $t$ years hence, the age of A would be $n_2$ times that of B, then

A's present age $= \left(\dfrac{n_2 - 1}{n_1 - n_2}\right) n_2 t$ years

and B's present age $= \left(\dfrac{n_2 - 1}{n_1 - n_2}\right) t$ years

**Explanation**

Let the present age of B be $x$ years.

Then, the present age of A = $n_1 x$

Given, $t$ years hence,

$$(n_1 x + t) = n_2\ (x + t)$$

or, $$(n_1 - n_2)x = (n_2 - 1)t$$

or, $$x = \left(\frac{n_2 - 1}{n_1 - n_2}\right) t$$

Therefore, B's present age = $\left(\dfrac{n_2-1}{n_1-n_2}\right)n_1 t$ years

and, A's present age = $\left(\dfrac{n_2-1}{n_1-n_2}\right)n_1 t$ years.

**Illustration 2:** The age of Mr Gupta is four times the age of his son. After ten years, the age of Mr Gupta will be only twice the age of his son. Find the present age of Mr Gupta's son.

**Solution:** The present age of Mr Gupta's son

$$= \left(\frac{n_2-1}{n_1-n_2}\right)t$$

$$= \left(\frac{2-1}{4-2}\right)10$$

[Here, $n_1 = 4$, $n_2 = 2$ and $t = 10$]

= 5 years.

> 3. The age of A, $t_1$ years ago, was $n_1$ times the age of B. If $t_2$ years hence A's age would be $n_2$ times that of B, then,
>
> A's present age = $\dfrac{n_1(t_1+t_2)(n_2-1)}{n_1-n_2}$ + $t_1$ years
>
> and, B's present age = $\dfrac{t_2(n_2-1)+t_1(n_1-1)}{n_1-n_2}$ years.

**Explanation**

Let A's present age = $x$ years and B's present age = $y$ years.

Given: $x - t_1 = n_1\ (y - t_1)$ and $x + t_2 = n_2\ (y + t_2)$

i.e., $x - n_1\ y = (1 - n_1)\ t_1$ (1)

and, $x - n_2\ y = (-1 + n_2)\ t_2$ (2)

Solving (1) and (2), we get

$$x = \frac{n_1(t_1+t_2)(n_2-1)}{n_1-n_2}+t_1$$

and, $$y = \frac{t_2(n_2-1)+t_1(n_1-1)}{n_1-n_2}.$$

**Illustration 3:** 10 years ago Anu's mother was 4 times older than her daughter. After 10 years, the mother will be twice older than her daughter. Find the present age of Anu is:

**Solution:** Present age of Anu

$$= \frac{t_1(n_2-1)+t_1(n_1-1)}{n_1-n_2}$$

[Here, $n_1 = 4$, $n_2 = 2$, $t_1 = 10$ and $t_2 = 10$]

$$= \frac{10(2-1)+10(4-1)}{4-2} = \frac{10-30}{2} = 20 \text{ years.}$$

> 4. The sum of present ages of A and B is $S$ years. If, $t$ years ago, the age of A was $n$ times the age of B, then
>
> Present age of A = $\dfrac{Sn-t(n-1)}{n-1}$ years,
>
> and, Present age of B = $\dfrac{S+t(n-1)}{n+1}$ years.

**Explanation**

Let the present ages of A and B be $x$ and $y$ years respectively.

Given: $x + y = S$ (1)

and, $x - t = n\ (y - t)$

or, $x - ny = (1 - n)t$ (2)

Solving (1) and (2), we get

$$x = \frac{Sn-t(n-1)}{n+1}$$

and, $$y = \frac{S+t(n-1)}{n+1}.$$

**Illustration 4:** The sum of the ages of A and B is 42 years. 3 years back, the age of A was 5 times the age of B. Find the difference between the present ages of A and B.

**Solution:** Here, $S = 42$, $n = 5$ and $t = 3$

∴ Present age of A

$$= \frac{Sn-t(n-1)}{n+1} = \frac{42\times5-3(5-1)}{5+1}$$

$$= \frac{198}{6} = 33 \text{ years}$$

and, present age of B

$$= \frac{5+t(n+1)}{n+1} = \frac{42+3(5-1)}{5+1}$$

$$= \frac{54}{6} = 9 \text{ years.}$$

∴ Difference between the present ages of A and B = 33 − 9 = 24 years.

**Notes:**

If, instead of sum ($S$), difference ($D$) of their ages is given, replace $S$ by $D$ and in the denominator $(n + 1)$ by $(n - 1)$ in the above formula.

5. The sum of present ages of A and B is $S$ years. If, $t$ years hence, the age of A would be $n$ times the age of B, then

   present age of A = $\dfrac{Sn+t(n-1)}{n+1}$ years

   and, present age of B = $\dfrac{S-t(n-1)}{n+1}$ years.

**Explanation**

Let the present ages of A and B be $x$ and $y$ years, respectively

Given: $x + y = S$ (1)

and, $x + t = n(y + t)$

or, $x - ny = t(n - 1)$ (2)

Solving (1) and (2), we get

$$x = \frac{Sn+t(n-1)}{n+1}$$

and, $$y = \frac{S-t(n-1)}{n+1}.$$

**Illustration 5:** The sum of the ages of a son and father is 56 years. After four years, the age of the father will be three times that of his son. Find their respective ages.

**Solution:** The age of the father

$$= \frac{Sn+t(n-1)}{n+1} = \frac{56\times3+4(3-1)}{3+1}$$

[Here, $S = 56$, $t = 4$ and $n = 3$]

$$= \frac{176}{4} = 44 \text{ years}$$

The age of son = $\dfrac{S-t(n-1)}{n+1}$

$$= \frac{56-4(3-1)}{3+1}$$

$$= \frac{48}{4} = 12 \text{ years.}$$

6. If the ratio of the present ages of A and B is $a{:}b$ and $t$ years hence, it will be $c{:}d$, then

   A's present age = $\dfrac{at(c-d)}{ad-bc}$

   and, B's present age = $\dfrac{bt(c-d)}{ad-bc}$.

**Illustration 6:** The ratio of the age of father and son at present is 6:1. After 5 years, the ratio will become 7:2. Find the present age of the son.

**Solution:** The present age of the son = $\dfrac{bt(c-d)}{ad-bc}$

[Here, $a = 6$, $b = 1$, $c = 7$, $d = 2$ and $t = 5$]

$$= \frac{1\times5(7-2)}{6\times2-1\times7} = 5 \text{ years.}$$

**Notes:**

If, with the ratio of the present ages, the ratio of the ages $t$ years ago is given, then replace $t$ by $(-t)$ in the above formula.

**Illustration 7:** 6 years ago Mahesh was twice as old as Suresh. If the ratio of their present ages is 9:5 then, what is the difference between their present ages?

**Solution:** Present age of Mahesh

$$= \frac{-at(c-d)}{ad-bc}$$

$$= \frac{-9\times6(2-1)}{1\times9-5\times2}$$

[Here, $a = 9$, $b = 5$, $c = 2$, $d = 1$ and $t = 6$ ]

$= 54$ years

Present age of Suresh

$$= \frac{-bt(c-d)}{ad-bc}$$

$$= \frac{-5\times6(2-1)}{1\times9-5\times2} = 30 \text{ years.}$$

$\therefore$ Difference of their ages $= 54 - 30 = 24$ years.

## EXERCISE-1

**1.** 10, years ago, Mohan was thrice as old as Ram was but 10 years hence, he will be only twice as old as Ram. Find Mohan's present age.

(a) 60 years (b) 80 years
(c) 70 years (d) 76 years

**2.** The ages of Ram and Shyam differ by 16 years. 6 years ago, Mohan's age was thrice as that of Ram's, find their present ages.

(a) 14 years, 30 years
(b) 12 years, 28 years
(c) 16 years, 34 years
(d) 18 years, 38 years

**3.** 15 years hence, Rohit will be just four times as old as he was 15 years ago. How old is Rohit at present?

(a) 20 (b) 25
(c) 30 (d) 35

**4.** A man's age is 125% of what it was 10 years ago, but $83\frac{1}{3}\%$ of what it will be after ten 10 years. What is his present age?

(a) 45 years (b) 50 years
(c) 55 years (d) 60 years

**5.** If twice the son's age be added to the father's age, the sum is 70 years and if twice the father's age is added to the son's age, the sum is 95 years. Then father's age is:

(a) 40 years (b) 35 years
(c) 42 years (d) 45 years

**6.** 3 years ago, the average age of a family of 5 members was 17 years. A baby having been born, the average age of the family is the same today? What is the age of the child?

(a) 3 years (b) 5 years
(c) 2 years (d) 1 year

**7.** The ratio of A's and B's ages is 4:5. If the difference between the present age of A and B 5 years hence is 3, then what is the sum of present ages of A and B?

(a) 68 years (b) 72 years
(c) 76 years (d) 64 years

**8.** The ages of A and B are in the ratio 6:5 and sum of their ages is 44 years. The ratio of their ages after 8 years will be:

(a) 4:5 (b) 3:4
(c) 3:7 (d) 8:7

**9.** One year ago the ratio between Samir and Ashok's age was 4:3. One year hence the ratio of their ages will be 5:4. What is the sum of their present ages in years?

(a) 12 years (b) 15 years
(c) 16 years (d) Cannot be determined

**10.** Ratio of Ashok's age to Pradeep's age is 4:3. Ashok will be 26 years old after 6 years. How old is Pradeep now?

(a) 18 years (b) 21 years
(c) 15 years (d) 24 years

**11.** Jayesh is as much younger to Anil as he is older to Prashant. If the sum of the ages of Anil and Prashant is 48 years, what is the age of Jayesh?

(a) 20 years (b) 24 years
(c) 30 years (d) Cannot be determined

**12.** 5 years ago Mr Sohanlal was thrice as old as his son and 10 years hence he will be twice as old as his son. Mr Sohanlal's present age (in years) is:

(a) 35 (b) 45
(c) 50 (d) 55

**13.** Three times the present age of a father is equal to eight times the present age of his son. 8 years hence the father will be twice as old as his son at that time. What are their present ages?

(a) 35, 15 (b) 32, 12
(c) 40, 15 (d) 27, 8

**14.** The sum of the ages of a father and son is 45 years. 5 years ago, the product of their ages was four times the father's age at that time. The present age of the father is:

(a) 39 years (b) 36 years
(c) 25 years (d) None of these

**15.** One year ago a father was four times as old as his son. In 6 years time his age exceeds twice his son's age by 9 years. Ratio of their ages is:

(a) 13:4 (b) 12:5
(c) 11:3 (d) 9:2

**16.** The ages of A, B and C together is 185 years. B is twice as old as A and C is 17 years older than A. Then, the respective ages of A, B and C are:

(a) 40, 86 and 59 years (b) 42, 84 and 59 years
(c) 40, 80 and 65 years (d) None of these

17. A father's age is three times the sum of the ages of his two children, but 20 years hence his age will be equal to the sum of their ages. Then, the father's age is:

(a) 30 years (b) 40 years
(c) 35 years (d) 45 years

## Exercise-2
## (Based on Memory)

1. The difference between the present ages of Arun and Deepak is 14 years. Seven years ago the ratio of their ages was 5:7 respectively. What is Deepak's present age?

(a) 49 years (b) 42 years
(c) 63 years (d) 35 years
(e) None of these

**[SBI PO, 2008]**

2. The ages of Sachin and Jatin are in the ratio 8:11. After 10 years the ratio of their ages will be 13:16. What is the difference in their ages?

(a) 16 years (b) 3 years
(c) 8 years (d) 6 years
(e) None of these

**[Corporation Bank PO, 2007]**

3. One year ago the ratio of the ages of Sanika and Gouri was 3:4 respectively. One year hence the ratio of their ages will be 10:13 respectively. What is Sanika's present age?

(a) 18 years (b) 20 years
(c) 26 years (d) Cannot be determined
(e) None of these

**[OBC PO, 2007]**

4. The present age of Mr Sanyal is 3 times the present age of his son. Six years hence the ratio of their ages will be 5:2. What is the present age of Mr Sanyal?

(a) 50 years (b) 48 years
(c) 54 years (d) 60 years
(e) None of these

**[OBC PO, 2007]**

5. The ages of Samir and Tanuj are in the ratio of 8:15. After 9 years the ratio of their ages will be 11:18. What is the difference between their ages?

(a) 24 years (b) 20 years
(c) 33 years (d) 21 years
(e) None of these

**[Bank of Baroda PO, 2007]**

6. The present ages of A, B and C are in the ratio of 8:14:22. The present ages of B, C and D are in the ratio 21:33:44. Which of the following respresents the ratio of the present ages of A, B, C and D?

(a) 12:21:33:44 (b) 12:22:31:44
(c) 12:21:36:44 (d) Cannot be determined
(e) None of these

**[SBI PO, 2005]**

7. Present ages of Seema and Naresh are in the ratio of 5:7. Five years hence the ratio of their ages becomes 3:4. What is Naresh's present age in years?

(a) 25 (b) 40
(c) 30 (d) Cannot be determined
(e) None of these

**[SBI PO, 2005]**

8. The average age of 11 players of a cricket team is increased by 2 months when two of them aged 18 years and 20 years are replaced by two new players. The average age of the new players is:

(a) 19 years 1 month (b)19 years 6 months
(c) 19 years 11 months (d)19 years 5 months

**[SSC (GL) Prel, 2005]**

9. The average age of 30 boys in a class is 15 years. One boy aged 20 years left the class, but two new boys came in his place whose ages differ by 5 years. If the average age of all the boys now in the class still remains 15 years, then the age of the younger newcomer is:

(a) 20 years (b) 15 years
(c) 10 years (d) 8 years

**[SSC (GL) Prel, 2005]**

10. The ratio of the present ages of two brothers is 1:2 and 5 years back the ratio was 1:3. What will be the ratio of their ages after 5 years?

(a) 1:4 (b) 2:3
(c) 3:5 (d) 5:6

**[SSC (GL) Prel, 2005]**

11. 6 years ago, Seema was half of that of Rupa in age. Four years hence the ratio of their ages would be 3:5. How old is Rupa at present?

(a) 32 years (b) 16 years
(c) 40 years (d) Cannot be determined
(e) None of these

**[BSRB Bhubaneshwar Bank Clerical Examination, 2001]**

**12.** Father is aged three times more than his son Ramu. After 8 years, he would be $2\frac{1}{2}$ times of Ramu's age. After further 8 years, how many times would he be of Ramu's age?

(a) 2 times (b) $2\frac{1}{2}$ times
(c) $2\frac{3}{4}$ times (d) 3 times

**[SI Rec. Examination CPO, 1998]**

**13.** The present age of a father is 3 years more than three times the age of his son. Three years hence, father's age will be 10 years more than twice the age of the son. The father's present age is:

(a) 33 years (b) 39 years
(c) 45 years (d) 40 years

**[SSC (GL) Prel. Examination, 1999]**

**14.** My grandfather was 8 times older than me 16 years ago. He would be 3 times of my age 8 years from now. Eight years ago, what was the ratio of my age to that of my grandfather?

(a) 3:8 (b) 1:5
(c) 1:2 (d) None of these

**[SSC (GL) Prel. Examination, 2003]**

**15.** In a class, the average age of 40 boys is 13.5 years and that of the girls is 13 years. The average age of the whole class is 13.4 years. Find the number of girls in the class.

(a) 20 (b) 13
(c) 11 (d) 10

**[SSC (GL) Prel. Examination, 2000]**

**16.** The average age of 8 men is increased by 2 years when two of them whose ages are 21 and 23 years are replaced by two new men. The average age of the two new men is:

(a) 22 years (b) 24 years
(c) 28 years (d) 30 years

**[SSC (GL) Prel. Examination, 2000]**

**17.** In a school with 600 students, the average age of the boys is 12 years and that of the girls is 11 years. If the average age of all the students of the school is 11 years and 9 months, then the numbers of girls in the school is:

(a) 450 (b) 250
(c) 150 (d) 350

**[SI Rec. Examination in CPO, 1998]**

**18.** A father said to his son 'I was as old as you are at present at the time of your birth'. If the father's age is 38 years now, the son's age five years back was:

(a) 14 years (b) 19 years
(c) 38 years (d) 33 years

**[Assistant's Grade Examination, 1998]**

**19.** The average age of a husband and wife was 23 years at the time of their marriage. After 5 years they have a one year old child. The average age of the family now is:

(a) 28.5 years (b) 19 years
(c) 29.9 years (d) 23 years

**[Assistant's Grade Examination, 1998]**

**20.** Renu's mother was three times as old as Renu 5 years ago. After 5 years, she will be twice as old as Renu. Renu's present age in years is:

(a) 35 (b) 10
(c) 20 (d) 15

**[Assistant's Grade Examination, 1998]**

**21.** The average age of a class of 20 students is 20 years. If the teacher's age is also included the average age increases by one year. The teacher's age is:

(a) 24 years (b) 30 years
(c) 41 years (d) 44 years

**[Assistant's Grade Examination, 1998]**

**22.** The average age of $x$ and $y$ is 18. If $z$ is equal to 9 then, the average of $x$, $y$ and $z$ is:

(a) 3 (b) 9
(c) 12 (d) 15

**[SSC (GL) Prel. Examination, 1999]**

**23.** The average age of 12 players of a team is 25 years. If the captain's age is included, the average age increases by 1 year. The age of the captain is:

(a) 25 years (b) 38 years
(c) 36 years (d) 26 years

**[SSC (GL) Prel. Examination, 1999]**

**24.** The average age of 24 students and the class teacher is 16 years. If the class teacher's age is excluded, the average reduces by one year. What is the age of the class teacher?

(a) 50 years (b) 45 years
(c) 40 years (d) Data inadequate
(e) None of these

**[SI Rec. Examination in Delhi Police, 1997]**

**25.** If the ages of P and R are added to twice the age of Q, the total becomes 59. If the ages of Q and R

are added to thrice the age of P, the total become 68. And, if the age of P is added to thrice the age of Q and twice the age of R, the total becomes 108. What is the age of P?

(a) 15 years (b) 19 years
(c) 17 years (d) 12 years
(e) None of these

**[SBI PO, 1999]**

**26.** The product of the ages of Harish and Seema is 240. If twice the age of Seema 4 years is more than Harish's then, what is Seema's age in years?

(a) 12 (b) 20
(c) 10 (d) 14
(e) Data inadequate

**[SBI PO, 1999]**

**27.** The average age of 34 boys in a class is 14 years If the teacher's age is included the average age of the boys and the teacher becomes 15. What is the teacher's age?

(a) 48 years (b) 46 years
(c) 49 years (d) 45 years
(e) None of these **[SBI PO, 2000]**

**28.** Q is as much younger than R as he is older than T. If the sum of the ages of R and T is 50 years, what is definitely the difference between R and Q's age?

(a) 25 years (b) 1 year
(c) 2 years (d) Data inadequate
(e) None of these **[SBI PO, 2000]**

**29.** The ratio between the ages of a father and a son at present is 5:2, 4 years, hence the ratio between the ages of the son and his mother will be 1:2. What is the ratio between the present ages of the father and the mother?

(a) 3:4 (b) 5:4
(c) 4:3 (d) Cannot be determined

**[Allahabad Bank PO, 2010]**

**30.** Radha's present age is three years less than twice her age 12 years ago. Also the ratio between Raj's persent age and Radha's present age in 4:9. What will be Raj's age after 5 years?

(a) 12 years (b) 7 years
(c) 21 years (d) None of these

**[Punjab and Sind Bank PO, 2010]**

**31.** The ratio of the present ages of Swati and Trupti is 4:5. 6 years hence the ratio of their ages will be 6:7. What is the difference between their ages?

(a) 2 years (b) 3 years
(c) 4 years (d) Cannot be determined

**[Punjab National Bank PO, 2010]**

**32.** 4 years ago Shayam's age was $\frac{3}{4}$ times that of Ram. 4 years hence, Shayam's age will be $\frac{5}{6}$ times that of Ram. What is the present age of Shayam?

(a) 15 years (b) 20 years
(c) 4 years (d) 24 years

**[Corporation Bank PO, 2009]**

**33.** The ratio of the present ages of Anju and Sandhya is 13:17, 4 years ago the ratio of their ages was 11:15. What will be the ratio of their ages 6 years hence ?

(a) 3:4 (b) 7:8
(c) 5:4 (d) None of these

**[Corporation Bank PO, 2010]**

**34.** The ages of Melwyn and Louis are in the ratio of 7:10. After 6 years the ratio of their age will be 17:23. What is the difference in their ages?

(a) 8 years (b) 4 years
(c) 12 years (d) 10 years

**[New Indian Insurance PO, 2009]**

**35.** The ages of Bhakti and Neil are in the ratio of 8:7. After 6 years, the ratio of their ages will be 19:17. What is the difference in their ages?

(a) 4 years (b) 8 years
(c) 10 years (d) 12 years

**[Haryana Grameen Bank PO, 2009]**

**36.** The ages of Sulekha and Arunima are in the ratio of 9:8. After 5 years the ratio of their ages will be 10:9. What is the difference between their ages (in years)?

(a) 4 years (b) 5 years
(c) 6 years (d) 7 years

**[Andhra Bank PO, 2008]**

**37.** The present ages of Amit and his father are in the ratio of 2:5. 4 years hence the ratio of the their ages will become 5:11. What was the father's age 5 years ago?

(a) 40 years (b) 45 years
(c) 30 years (d) 35 years

**[Andhra Bank PO, 2009]**

**38.** The ages of Ranjana and Rakhi are in the ratio of 15:17. After 6 years the ratio of their ages will be 9:10. What will be the age of Ranjana after 6 years?

(a) 40 years (b) 30 years
(c) 34 years (d) 36 years

**[Uttrakhand GBO PO, 2007]**

**39.** The ratio between the present age of Manisha and Deepali is 5:$x$. Manisha is 9 years younger than Parineeta. Parineeta's age after 9 years will be

33 years. The difference between Deepali's and Manisha's age is same as the present age of Parineeta. What will come in place of $x$?

(a) 23 (b) 39
(c) 15 (d) None of these

**[IBPS Bank PO, 2011]**

**40.** The ages of Shirish and Kunder are in the ratio of 5:6. After 8 years the ratio of their ages will be 7:8. What is the difference in their ages?

(a) 4 years (b) 8 years
(c) 10 years (d) 12 years

**[OBC PO, 2009]**

**41.** The ages of Nishi and Vinnee are in the ratio of 6:5. After 9 years the ratio of their ages will be 9:8. What is the difference in their ages?

(a) 9 years (b) 7 years
(c) 5 years (d) 3 years

**[SBI PO, 2008]**

**42.** The total of the ages of a class of 75 girls is 1050, the average age of 25 of them is 12 years and that of another 25 is 16 years. Find the average age of the remaining girls.

(a) 12 years (b) 13 years
(c) 14 years (d) 15 years

**[SBI PO, 2008]**

**43.** Michelle got married 9 years ago. Today her age is $1\frac{1}{3}$ times her age at the time of marriage. At present her daughter's age is $\frac{1}{6}$ of her age. What was her daughter's age 2 years ago?

(a) 6 years (b) 7 years
(c) 3 years (d) None of the above

**[Dena Bank PO, 2008]**

**44.** The ratio between the present ages of Ram and Rakesh is 6:11. 4 years ago, the ratio of their ages was 1:2. What will be Rakesh's age after five years?

(a) 45 years (b) 29 years
(c) 49 years (d) Cannot be determined

**[Corporation Bank PO, 2011]**

**45.** The ratio between the present ages of Ram Rohan and Raj is 3:4:5. If the average of their present ages is 28 years then what will be the sum of the ages of Ram and Rohan together after 5 years?

(a) 45 years (b) 55 years
(c) 52 years (d) 59 years

**[Bank of Baroda PO Examination, 2011]**

**46.** The present ages of Vishal and Shekhar are in the ratio of 14:17. 6-years from now, their ages will be in the ratio of 17:20. What is Shekhar's present age ?

(a) 17 years (b) 51 years
(c) 34 years (d) 28 years

**[Bank of India PO, 2010]**

**47.** Ram's present age is three times his son's present age and $\frac{2}{5}$ of his father's present age. The average of the present ages of all of them is 46 years. What is the difference between the Ram's son's present age and Ram's father's present age?

(a) 68 years (b) 88 years
(c) 58 years (d) None of these

**[Bank of Baroda PO, 2010]**

**48.** At present, Meena is eight times her daughter's age. 8 years from now, the ratio of the ages of Meena and her daughter will be 10:3. What is Meena's present age?

(a) 32 years (b) 40 years
(c) 36 years (d) Cannot be determined

**[IDBI PO, 2009]**

**49.** The ratio of the ages of Anubha and her mother is 1:2. After 6 years the ratio of their ages will be 11:20. 9 years before, what was the ratio of their ages?

(a) 3:5 (b) 2:7
(c) 1:4 (d) 2:5

**[Syndicate Bank PO, 2010]**

**50.** The ratio of the age of Tina and Rakesh is 9:10. 10 years ago the ratio of their ages was 4:5. What is the present age of Rakesh?

(a) 25 years (b) 20 years
(c) 30 years (d) 24 years

**[Bank of Baroda PO, 2010]**

**51.** The average age of women and child workers in factory was 15 years. The average age of all the 16 children was 8 years and the average age of women workers was 22 years. If 10 women workers were married, then the number of unmarried women workers is:

(a) 16 (b) 12
(c) 8 (d) 6

**[UPPCS, 2012]**

**52.** The age of a father is three times of that of his son. After 5 years, the double of father's age will be five times the age of son. The present age of father and son is:

(a) 30 years, 10 years (b)36 years, 12 years
(c) 42 years, 14 years (d)45 years, 15 years

**[UPPCS, 2012]**

**53.** In a family, mother's age is twice that of daughter's age. Father is 10 years older than mother. Brother is 20 years younger than his mother and 5 years older than his sister. What is the age of the father?

(a) 62 years (b) 60 years
(c) 58 years (d) 55 years

**[SSC (GL), 2011]**

**54.** The ratio of the ages of Ram and Rahim 10 years ago was 1:3. The ratio of their ages 5 years hence will be 2:3. Then the ratio of their present ages is:

(a) 1:2 (b) 3:5
(c) 3:4 (d) 2:5

**[SSC (GL), 2011]**

**55.** The average age of 11 players of a cricket team is increased by 2 months when two of them aged 18 years and 20 years are replaced by two new players. The average age of the new players is:

(a) 19 years 1 month
(b) 19 years 6 months
(c) 19 years 11 months
(d) 19 years 5 months

**[SSC (GL), 2011]**

**56.** Shan is 55 years old, Sathian is 5 years junior to Shan and 6 years senior to Balan. The youngest brother of Balan is Devan and he is 7 years junior to him. So what is the age difference between Devan and Shan?

(a) 18 years (b) 15 years
(c) 13 years (d) 7 years

**[SSC (GL), 2011]**

**57.** A man is 3 years older than his wife and four times as old as his son. If the son becomes 15 years old after 3 years, what is the present age of the wife?

(a) 60 years (b) 51 years
(c) 48 years (d) 45 years

**[SSC (GL), 2010]**

**58.** After replacing an old member by a new member, it was found that the average age of five members of a club is same as it was 3 years ago. The difference between the ages of the replaced and the new members is:

(a) 2 years (b) 4 years
(c) 8 years (d) 15 years

**[SSC, 2014]**

**59.** 7 years ago, the ages (in years) of A and B were in the ratio 4:5; and 7 years hence they will be in the ratio 5:6. The present age of B is:

(a) 56 years (b) 63 years
(c) 70 years (d) 77 years

**[SSC, 2010]**

**60.** The ratio of the present ages of A and B is 7:9. 6 years ago the ratio of $\frac{1}{3}$ of A's age at that time and $\frac{1}{3}$ of B's ageat that time was 1:2. What will be the ratio of A's to B's age 6 years from now?

(a) 4:5 (b) 14:15
(c) 6:7 (d) 18:25
(e) 22:25

**[IBPS PO/MT, 2014]**

**61.** The present age of Romila is $\frac{1}{4}$ that of her father. After 6 years her father's age will be twice the age of Kapil. If Kapil celebrated fifth birthday 8 years ago, what is Romila's present age?

(a) 7 years (b) 7.5 years
(c) 8 years (d) 8.5 years
(e) None of these

**[IBPS PO/MT, 2013]**

**62.** The sum of the ages of 4 members of a family, 5 years ago, was 94 years. Today, when the daughter has been married off and replaced by a daughter-in-law, the sum of their ages is 92. Assuming that there has been no other change in the family structure and all the people are alive, what is the difference between the age of the daughter and that of the daughter-in-law?

(a) 22 years (b) 11 years
(c) 25 years (d) 19 years
(e) 15 years

**[IBPS PO/MT, 2012]**

**63.** The ratio of the present age of Manisha and Deepali is 5:*X*. Manisha is 9 years younger than Parineeta. After 9 years, parineeta's age will be 33 years. The difference between Deepali's and Manisha's age is the same as the present age of Parineeta. What should come in place of *X*?

(a) 23 (b) 39
(c) 15 (d) Cannot be determined
(e) None of these

**[IBPS PO/MT, 2011]**

**64.** The age of the father is 30 years more than the son's age. Ten years hence, the father's age will become three times the son's age that time. What is the son's present age in years?

(a) Eight (b) Seven
(c) Five (d) Cannot be determined
(e) None of these

**[SBI Associates Banks PO, 2011]**

**65.** The ratio of the present age of Manoj to that of Wasim is 3:11. Wasim is 12 years younger than Rehana. Rehana's age after 7 years will be 85 years. What is the present age of Manoj's father, who is 25 years older than Manoj?

(a) 43 years (b) 67 years
(b) 45 years (d) 69 years
(e) None of these

**[IOB PO, 2011]**

**66.** Raman's present age is three times his daughter's and $\frac{9}{13}$ of his mother's present age. The sum of the present ages of all three of them is 125 years. What is the difference between the present ages of Raman's daughter and Raman's mother?

(a) 45 years (b) 40 years
(c) 50 years (d) Cannot be determined
(e) None of these

**[Allahabad Bank PO, 2011]**

**67.** The ratio of the present ages of Ram and Rakesh 6:11. 4 years ago, the ratio of their ages was 1:2. What will be Rakesh's age after 5 years?

(a) 45 years (b) 29 years
(c) 49 years (d) Cannot be determined
(e) None of these

**[Corporation Bank PO, 2011]**

**68.** Radha's present age is 3 years less than twice her age 12 years ago. Also, the ratio of Raj's present age to Radha's present age is 4:9. What will be Raj's age after 5 years?

(a) 12 years (b) 7 years
(c) 21 years (d) Cannot be determined
(e) None of these

**[Punjab and Sind Bank PO, 2010]**

**69.** The ratio of the ages of a father and a son at present is 5:2. 4 years hence, the ratio of the ages of the son and his mother will be 1:2. What is the ratio of the present ages of the father and the mother?

(a) 3:4 (b) 5:4
(c) 4:3 (d) Cannot be determined
(e) None of these

**[Allahabad Bank PO, 2010]**

**70.** Ratio of the ages of Tania and Rakesh is 9:10. 10 years ago, the ratio of their ages was 4:5. What is the present age of Rakesh?

(a) 25 years (b) 20 years
(c) 30 years (d) 24 years
(e) None of these

**[Indian Bank PO, 2010]**

**71.** At present, Meena is eight times her daughter's age. 8 years from now, the ratio of the ages of Meena and her daughter will be 10:3. What is Meena's present age?

(a) 32 years (b) 40 years
(c) 36 years (d) Cannot be determined
(e) None of these

**[IDBI Bank PO, 2009]**

**72.** The ages of Shirish and Kunder are in the ratio of 5:6. After 8 years, the ratio of their ages will be 7:8. What is the difference in their ages?

(a) 4 years (b) 8 years
(c) 10 years (d) 12 years
(e) None of these

**[OBC PO, 2009]**

**73.** In a class, there are 32 boys and 28 girls. The average age of the boys in the class is 14 years, and the average age of the girls in the class is 13 years. What is the average age of the whole class? (Rounded off to two digits after decimal)

(a) 13.50 (b) 13.53
(c) 12.51 (d) 13.42
(e) None of these

**[NABARD Bank Officer 2009]**

**74.** 4 years ago Shyam's age was $\frac{3}{4}$ times that of Ram. 4 years hence, Shyam's age will be $\frac{5}{6}$ times that of Ram. What is the present age of Shyam?

(a) 15 years (b) 20 years
(c) 16 years (d) 24 years
(e) 8 years

**[Corporation Bank PO, 2009]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (a) | **3.** (b) | **4.** (b) | **5.** (a) | **6.** (c) | **7.** (b) | **8.** (d) | **9.** (c) | **10.** (c) | **11.** (b) | **12.** (c) | **13.** (b) |
| **14.** (b) | **15.** (c) | **16.** (b) | **17.** (a) | | | | | | | | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (e) | **2.** (d) | **3.** (e) | **4.** (c) | **5.** (d) | **6.** (a) | **7.** (e) | **8.** (c) | **9.** (b) | **10.** (c) | **11.** (e) | **12.** (a) | **13.** (a) |
| **14.** (d) | **15.** (d) | **16.** (d) | **17.** (c) | **18.** (b) | **19.** (b) | **20.** (d) | **21.** (c) | **22.** (d) | **23.** (b) | **24.** (c) | **25.** (d) | **26.** (a) |
| **27.** (c) | **28.** (d) | **29.** (d) | **30.** (d) | **31.** (b) | **32.** (c) | **33.** (d) | **34.** (c) | **35.** (a) | **36.** (b) | **37.** (d) | **38.** (d) | **39.** (d) |
| **40.** (a) | **41.** (d) | **42.** (c) | **43.** (d) | **44.** (c) | **45.** (d) | **46.** (c) | **47.** (d) | **48.** (a) | **49.** (d) | **50.** (b) | **51.** (d) | **52.** (d) |
| **53.** (b) | **54.** (b) | **55.** (c) | **56.** (a) | **57.** (c) | **58.** (d) | **59.** (d) | **60.** (c) | **61.** (c) | **62.** (a) | **63.** (e) | **64.** (c) | **65.** (a) |
| **66.** (c) | **67.** (c) | **68.** (e) | **69.** (d) | **70.** (b) | **71.** (a) | **72.** (a) | **73.** (b) | **74.** (c) | | | | |

## EXPLANATORY ANSWERS

### Exercise-1

**1.** **(c)** Let, Mohan's present age be $x$ years and Ram's present age be $y$ years.

Then, according to the first condition,

$x - 10 = 3(y - 10)$

or, $x - 3y = -20$ …(1)

Now, Mohan's age after 10 years

$= (x + 10)$ years

Ram's age after 10 years $= (y + 10)$

$\therefore \quad (x + 10) = 2(y + 10)$

or, $x - 2y = 10$ …(2)

Solving (1) and (2), we get

$x = 70$ and, $y = 30$

$\therefore$ Mohan's age = 70 years and Ram's age = 30 years.

**2.** **(a)** Let, Ram's age = $x$ years

So, Mohan's age = $(x + 16)$ years

Also, $3(x - 6) = x + 16 - 6$ or, $x = 14$

$\therefore$ Ram's age = 14 years

and, Mohan's age = 14 + 16 = 30 years.

**3.** **(b)** Let, the present age of Rohit be $x$ years

Then, given: $x + 15 = 4(x - 15) \Rightarrow x = 25$.

**4.** **(b)** Let, the present age be $x$ years.

Then, 125% of $(x - 10) = x$

and, $83\frac{1}{3}$% of $(x + 10) = x$

$\therefore \quad 125$ % of $(x - 10) = 83\frac{1}{3}$% of $(x + 10)$

or, $\frac{5}{4}(x - 10) = \frac{5}{6}(x + 10)$

or, $\frac{5}{4}x - \frac{5}{6}x = \frac{50}{6} + \frac{50}{4}$

or, $\frac{5x}{12} = \frac{250}{12}$ or, $x = 50$ years.

**5.** **(a)** Let, son's age ( in years ) = $x$ and father's age (in years) = $y$

Given: $2x + y = 70$ and, $x + 2y = 95$

Solving for $y$, we get $y = 40$.

**6.** **(c)** Present age of 5 members

$= 5 \times 17 + 3 \times 5 = 100$ years

Also, present ages of 5 members + Age of the baby

$= 6 \times 17 = 102$ years

$\therefore$ Age of the baby = 102 − 100 = 2 years.

**7.** **(b)** Given: $\frac{A}{B} = \frac{4}{5}$ or, $B = \frac{5}{4}A$

and, $B - (A + 5) = 3$ or, $B = A + 8$

$\therefore \quad \frac{5}{4}A = A + 8$

or, $A\left(\frac{5}{4} - 1\right) = 8$

$\therefore$ A = 32 years

and, B = $\frac{5}{4} \times 32 = 40$ years

$\therefore$ A + B = 40 + 32 = 72 years.

**8.** **(d)** Let, present ages (in years) of A and B respectively, are $6x$ and $5x$.

Given: $6x + 5x = 44 \Rightarrow x = 4$

Ratio of ages after 8 years will be

$6x + 8 : 5x + 8$

or, 32:28 or, 8:7.

**9.** **(c)** Let, one year ago

Samir's age be $4x$ years

and, Ashok's age be $3x$ years

Present age of Samir = $(4x + 1)$ years

Present age of Ashok = $(3x + 1)$ years

One year hence

Samir's age = $(4x + 2)$ years

Ashok's age = $(3x + 2)$ years

According to question,

$\frac{4x+2}{3x+2} = \frac{5}{4} \Rightarrow 16 + 8 = 15x + 10$

or, $x = 2$.

$\therefore$ Sum of their present ages = $4x + 1 + 3x + 1$

$= 7x + 2$

$= 7 \times 2 + 2 = 16$ years.

**10.** **(c)** Let, the present ages of Ashok and Pradeep be $4x$ and $3x$

So that $4x + 6 = 26 \Rightarrow x = 5$

$\therefore$ Present age of Pradeep is $3x = 3 \times 5$, i.e., 15 years

**11.** **(b)**

**12.** **(c)** Let, Mr Sohanlal's age (in years) = $x$

and his son's age = $y$

Then, $x - 5 = 3(y - 5)$ i.e., $x - 3y + 10 = 0$

and, $x + 10 = 2(y + 10)$ i.e., $x - 2y - 10 = 0$

Solving the two equations, we get

$x = 50, y = 20$.

**13.** **(b)**

**14.** **(b)** Let, father's present age = $x$ years

Then, son's present age = $(45 - x)$ years

Given: $(x - 5)(45 - x - 5) = 4(x - 5)$

or, $x^2 - 41x + 180 = 0$ or, $(x - 36)(x - 5) = 0$

$\therefore$ $x = 36$ years.

**15.** **(c)** Let, the present ages of father and son be $x$ and $y$ years, respectively

Then, $(x - 1) = 4(y - 1)$

or, $4y - x = 3$ ...(1)

and, $(x + 6) - 2(y + 6) = 9$

or, $-2y + x = 15$ ...(2)

Solving (1) and (2), we get, $x = 33$, $y = 9$

$\therefore$ Ratio of their ages = 33:9 = 11:3.

**16.** **(b)** Let, A's age be $x$ years

B's age be $2x$ years

C's age = $(x + 17)$ years

According to the question,

$$x + 2x + (x + 17) = 185$$

$\therefore$ $4x = 185 - 17 = 168$ $\therefore$ $x = 42$

$\therefore$ A's age = 42 years

B's age = 84 years

C's age = 42 + 17 = 59 years.

**17.** **(a)** Let, the present age of father be $x$ years and the present age of son be $y$ years.

$\therefore$ $x = 3y$ ...(1)

Also, $(x + 20) = (y + 20 + 20)$ ...(2)

Solving (1) and (2), we get

$x = 30$ years.

## Exercise-2
## (Based on Memory)

**1.** **(e)** Let, the present ages of Arun and Deepak be $x$ and $y$ years respectively.

$\therefore$ $y - x = 14$

$\therefore$ $x = y - 14$

and, $\frac{x-7}{y-7} = \frac{5}{7}$

$7x - 49 = 5y - 35$

$\Rightarrow 7(y - 14) - 49 = 5y - 35$

$\Rightarrow 7y - 98 - 49 = 5y - 35$

$\Rightarrow 7y - 5y = 98 + 49 - 35$

$\therefore$ $y = 56$ years

**2.** **(d)** $\frac{8x+10}{11x+10} = \frac{13}{16}$

$\Rightarrow 128x + 160 = 143x + 130 \quad \therefore \quad x = \frac{30}{15} = 2$

$\therefore$ difference in their ages

$= 11x - 8x = 3x = 3 \times 2 = 6$ years.

**3.** **(e)** We have $\frac{S-1}{G-1}=\frac{3}{4}\Rightarrow 4S-3G=1$ ...(1)

and $\frac{S+1}{G+1}=\frac{10}{13}\Rightarrow 13S-10G=-3$ ...(2)

Solving (1) and (2), we have, S = 19 years.

**4.** **(c)** Let, son's age = $x$, Sanyal's age = $3x$

$\frac{3x+6}{x+6}=\frac{5}{2}\Rightarrow 6x+12=5x+30 \quad x = 18$

Sanyal's age = $3x$ = 3 × 18 = 54.

**5.** **(d)** We have $\frac{(8k+9)}{(15k+9)}=\frac{11}{18}$

or, $144k + 162 = 165k + 99$

or, $21k = 63$

∴ $k = 3$

∴ Required difference = (15 − 8) × 3 = 21

**6.** **(a)** ∴ A:B:C = 8:14:22

= 12:21:33

B:C:D = 21:33:44

∴ A:B:C:D = 12:21:33:44

**7.** **(e)** Let, the present ages of Seema and Naresh be $5x$ years and $7x$ years respectively.

∴ $\frac{5x+5}{7x+5}=\frac{3}{4}$

⇒ $21x + 15 = 20x + 20$

⇒ $x = 5$

∴ Present age of Naresh = 35 years.

**8.** **(c)** Let, the average age of 11 players be $x$.

∴ When two players aged 18 years and 20 years are replaced by two new players, the average age of 11 players

$=\frac{11x-18-20+2p}{11}=x+\frac{1}{6}$

where $p$ is the average age of the two new players.

∴ $11x - 18 - 20 + 2p = 11x + \frac{11}{6}$

⇒ $2p=38+\frac{11}{6}\Rightarrow p=19+\frac{11}{12}$

⇒ Average age of the two new players

= 19 years and 11 months.

**9.** **(b)** Let, the ages of the two new boys be $x$ and $x + 5$ respectively.

∴ $\frac{450-20+x+(x+5)}{31}=15$

⇒ $2x - 15 = 31 \times 15 - 450 = 15$

⇒ $x = 15$

∴ Age of the younger newcomer = 15 years

**10.** **(c)** Let the ratio of the present ages of the two brothers be $x$:$y$.

∴ $\frac{x}{y}=\frac{1}{2},\frac{x-5}{y-5}=\frac{1}{3}$

⇒ $3(x - 5) = y - 5$

⇒ $3x - y = 10$

⇒ $x = 10$ [∵ $y = 2x$]

⇒ $y = 20$

∴ $\frac{x+5}{y+5}=\frac{15}{25}=\frac{3}{5}$

= Ratio of the ages of the two brothers after 5 years.

**11.** **(e)** Let, Seema's age at present be $x$ years and Rupa's age be $y$ years.

Now, according to the question,

$(y - 6) = 2\,(x - 6) \Rightarrow y - 6 = 2x - 12$

or, $2x - y = 6$ ...(1)

Also, $\frac{x+4}{y+4}=\frac{3}{5}$

or, $5x + 20 = 3y + 12$

or, $5x - 3y = -8$ ...(2)

From equations (1) and (2), we get

$x$ = 26 years and $y$ = 46 years

**12.** **(a)** Given: F = R + 3R = 4R ...(1)

and, $F + 8 = 2\frac{1}{2}(R + 8) = \frac{5}{2}(R + 8)$ ...(2)

F + 16 = ? × (R + 16)

(1) and (2) gives F = 32 and R = 8

∴ F + 16 = 48, $R$ + 16 = 24.

**13.** **(a)** Given: F − 3S = 3 ...(1)

and, (F + 3) − 2 (S + 3) = 10

or, F − 2S = 13 ...(2)

Solving (1) and (2), we get F = 33 years.

**14.** **(d)** Let, the present age of grandfather and me be '$x$' years and '$y$' years, respectively

Given: $x - 16 = 8\,(y - 16) \Rightarrow 8y - x = 112$ ...(1)

and, $x + 8 = 3\,(y + 8) \Rightarrow x - 3y = 16$ ...(2)

Solving (1) and (2), we get

$x = \frac{464}{5}$ and $y = \frac{128}{5}$

∴ Ratio 8 years ago = $y - 8 : x - 8$

= 88:424 = 11:53.

**15.** **(d)** Let, number of girls = K

40 × 13.5 + 13K = 13.4 (K + 40)

⇒ 13 K + 540 = 13.4K + 536

⇒ 0.4K = 4 ⇒ K = 10.

**16.** **(d)** Let, average age of 8 men be K and average age of two new men be M

∴ 8K − 21 − 23 + 2M = 8 (K +2) ⇒ M = 30.

**17.** **(c)** Let, number of girls = G

$\therefore$ Number of boys = 600 − G

Given: $12(600 - G) + 11G = 11\frac{3}{4} \times 600$

$\Rightarrow$ 7200 − 12 G + 11G = 7050

$\Rightarrow$ G = 150.

**18.** **(b)** At present, the son's age = 19 years.

**19.** **(b)** We have, H + W = 46

and, (H + 5) + (W + 5) + C = H + W + 10 + C

= 46 + 10 + 1 = 57

$\therefore$ Average age of H, W and C now = $\frac{57}{3}$ = 19.

**20.** **(d)** Given: $3(R - 5) = (M - 5)$

and, $2(R + 5) = (M + 5)$

$\therefore$ $M = 35$, $R = 15$.

**21.** **(c)** The teacher's age = 21 × 21 − 20 × 20

= 441 − 400 = 41 years.

**22.** **(d)** Given: $x + y = 36$ and $z = 9$

$\therefore$ $\frac{x+y+z}{3} = 15$.

**23.** **(b)** Age of the captain = (25 + 1) × 13 − 25 × 12

= 338 − 300 = 38 years.

**24.** **(c)** Age of the class teacher

= 25 × 16 − 24 ×15

= 400 − 360 = 40 years.

**25.** **(d)** P + R + 2Q = 59

Q + R + 3P = 68 and P + 3Q + 2R = 108

Solving these, we get

P = 12 years.

**26.** **(a)** Let, the ages of Harish and Seema be $x$ and $y$ years, respectively.

According to question,

$x \times y = 240$ …(1)

$2y - x = 4$ …(2)

Solving equations (1) and (2), we get

$y = 12$ years

**27.** **(c)** Teacher's age = 35 × 15 − 34 × 14

= 525 − 476 = 49 years.

**28.** **(d)**

**29.** **(d)** Let, the ages of father and son are $5x$ and $2x$ years.

After four years the age of son = $2x + 4$

After four years the age of mother = $4x + 8$

So the present age of mother = $4x + 4$

Ratio of the age of father and mother = $5x:(4x + 4)$

Data are insufficient, so cannot be determined.

**30.** **(d)** Present age of Radha = $x$ years.

According to question,

$x + 3 = 2(x - 12)$

$x + 3 = 2x - 24$

$x = 27$

Present age of Raj:Present age of Radha = 4:9

$\therefore$ Present age of Raj = $\frac{27}{9} \times 4 = 12$

After 5 years age of Raj = 12 + 5 = 17 years

**31.** **(b)** $\frac{S+6}{T+6} = \frac{6}{7}$

$7S + 42 = 6T + 36$

$7S - 6T = 36 - 42 \quad \left(\because \frac{S}{T} = \frac{4}{5}\right)$

$7 \times \frac{4T}{S} - 6T = -6$

$\frac{28T - 30T}{5} = -6$

$-2T = -30$

$\therefore$ $T = 15$ then $S = \frac{4T}{5} = \frac{4 \times 15}{5} = 12$

Difference = 15 − 12 = 3 years

**32.** **(c)** Age before 4 years.

Shyam:Ram = 3:4

After 4 years, age is

$\frac{3x+8}{4x+8} = \frac{5}{6}$

$20x + 40 = 18x + 48$

$20x - 18x = 48 - 40$

$2x = 8$

$x = 4$

**33.** **(d)** $\frac{13x-4}{17x-4} = \frac{11}{15}$

$195x - 60 = 187x - 44$

$195x - 187x = -44 + 60$

$8x = 16$

$x = 2$

Ratio of their ages after 6 years = $\frac{13 \times 2 + 6}{17 \times 2 + 6}$

$= \frac{32}{40} = \frac{4}{5} = 4:5$

**34.** **(c)** Let, the present age of Melwyn and Louis are $7x$ and $10x$. After 6 years the age is

$\frac{7x+6}{10x+6} = \frac{17}{23}$

$\Rightarrow$ $170x + 102 = 161x + 138$

$\Rightarrow$ $170x + 161x = 138 - 102$

$\Rightarrow$ $9x = 36$

$x = 4$

Age difference between Melwyn and Louis

$= 10x - 7x$

$= 3x = 3 \times 4$

= 12 years [Putting, $x = 4$]

**35.** **(a)** Let, the ages of Bhaki and Neil are $8x$ and $7x$ respectively.

After 6 years

$$\frac{8x+6}{7x+6} = \frac{19}{17}$$

$\Rightarrow$ $136x + 102 = 133x + 114$

$\Rightarrow$ $136x - 133x = 114 - 102$

$\Rightarrow$ $3x = 12$

$\Rightarrow$ $x = \frac{12}{3} = 4$

Age of Bhakti $= 8x = 8 \times 4 = 32$

Present age of Neil $= 7 \times x = 7 \times 4 = 28$

Required difference $= 32 - 28 = 4$ years

**36.** **(b)** Let, the age of Sulekha and Arunima is $9x$ and $8x$.

$\therefore$ $\frac{9x+5}{8x+5} = \frac{10}{9}$

$81x + 45 = 8x + 50$

$81x - 80x = 50 - 45$

$x = 5$

$\therefore$ Difference $= 9 \times 5 - 8 \times 5$

$= 45 - 40 = 5$ years

**37.** **(d)** Let, the present age of Amit and his father is $2x$ and $5x$ years respectively.

After 4 years the ratio of their ages,

$$\frac{2x+4}{5x+4} = \frac{5}{11}$$

$25x + 20 = 22x + 44$

$25x - 22x = 44 - 20$

$3x = 24$

$x = 8$

Age of his father before 5 years

$= 5x - 5$

$= 5 \times 8 - 5$ $[\because x = 8]$

$= 40 - 5$

$= 35$ years

**38.** **(d)** Let, the age of Ranjana and Rakhi is $15x$ years and $17x$ years.

After 6 years the age of Ranjana and Rakhi

$$\frac{15x+6}{17x+6} = \frac{9}{10}$$

$\Rightarrow$ $153x + 54 = 150x + 60$

$153x - 150x = 60 - 54$

$3x = 6x = 2$

So, the age of Ranjana after 6 years

$= 15 \times 2 + 6 = 30 + 6 = 36$ years

**39.** **(d)** Given Parineeta's age after 9 years = 33 years

$\therefore$ Parineeta's present age $= 33 - 9$

$= 24$ years

$\therefore$ Manisha's present age $= 24 - 9$

$= 15$ years

$\therefore$ Deepali's present age $= 15 + 24$

$= 39$ years

Hence, ratio between Manisha and Deepali

$= 15:39 = 5:13$

$\therefore$ $x = 13$

**40.** **(a)** Let, the age of Shirish $= 5x$ years

age of Kunder $= 6x$ years

$$\frac{5x+8}{6x+8} = \frac{7}{8}$$

$\Rightarrow$ $42x + 56 = 40x + 64$

$42x - 40x = 64 - 56$

$2x = 8$

$x = 4$

Required difference $= 6x - 5x$

$= 6 \times 4 - 5 \times 4$

$= 24 - 20$

$= 4$ years

**41.** **(d)** Let, the ages of Nishi and Vinnee and $6x$ and $5x$ years.

$\because$ $\frac{6x+9}{5x+9} = \frac{9}{8}$

$\Rightarrow$ $48x + 72 = 45x + 81$

$\Rightarrow$ $48x - 45x = 81 - 72$

$\Rightarrow$ $3x = 9$

$\because$ $x = 3$

Required difference

$6x - 5x = x = 3$ years

**42.** **(c)** Average age of the remaining grils

$$= \frac{1050-(25\times12+25\times16)}{25}$$

$$= \frac{1050-(300+400)}{25}$$

$$= \frac{1050-700}{25}$$

$= 14$ years

**43.** **(d)** Let, at the time of marriage, the age of Michelle was $x$ years.

$x + 9 = \frac{4}{3}x$

$\therefore$ $\frac{x}{3} = 9$

$\Rightarrow$ $x = 3 \times 9 = 27$ years

$\therefore$ Present age of Michelle

$= 27 + 9 = 36$ years

Here daughter's age two years ago

$= \frac{36}{6} - 2 = 6 - 2 = 4$ years

**44.** **(c)** Let, the age of Ram = $x$ and, Rakesh = $y$, then, $\frac{x}{y} = \frac{6}{11}$

$\therefore \quad x = \frac{6y}{11}$

According to the question,

$$\frac{x-4}{y-4} = \frac{1}{2}$$

$$2x - 8 = y - 4$$

$$2 \times \frac{6y}{11} - 8 = y - 4$$

$$\frac{12y}{11} - y = -4 + 8$$

$$\frac{y}{11} = 4$$

$\therefore \quad y = 44$ years

$\therefore$ Age of Rakesh after 5 years

= 44 + 5 = 49 years

**45.** **(d)** Let, the ages of Ram, Rohan and Raj be $3x$, $4x$ and $5x$ respectively.

Then,

$$\frac{3x+4x+5x}{3} = 28$$

$\Rightarrow \quad 4x = 28$

$\Rightarrow \quad x = \frac{28}{4} = 7$ years

So, the present ages of Ram and Rohan together

$= 3x + 4x$

$= 7x = 7 \times 7$

= 49 years

Hence, the sum of the ages of Ram and Rohan together after 5 years

$= 49 + 5 \times 2$

= 49 + 10

= 59 years

**46.** **(c)** $\frac{V}{S} = \frac{14}{17}$

$\therefore \quad V = \frac{14S}{17}$

Again, $\frac{V+6}{S+6} = \frac{17}{20}$

$$20V + 120 = 17S + 102$$

$$20 \times \frac{14S}{17} + 120 = 17S + 102$$

$$\frac{280S}{17} + 120 = 17S + 102$$

$$120 - 120 = \frac{17S - 280S}{17}$$

$$18 = \frac{289S - 280S}{17}$$

$$\frac{18 \times 17}{9} = S$$

$$34 = S$$

**47.** **(d)** Suppose age of Ram = R

His son's age = S

and his father's age = F

According to the question, $S = \frac{R}{3}$ and $R = F \times \frac{2}{5}$

$\therefore \quad F = \frac{5R}{2}$

and, $\frac{R+S+F}{3} = 46$

$$R + S + F = 46 \times 3$$

$$R + \frac{R}{3} + \frac{5R}{2} = 138$$

$$R = 36$$

$$S = \frac{36}{3} = 12$$

$$F = \frac{5 \times 36}{2} = 90$$

Difference = 90 − 12 = 78 years

**48.** **(a)** Let, the age of daughter = $x$ years

Age of Meena = $8x$ years

After 8 years

$$\frac{8x+8}{x+8} = \frac{10}{3}$$

$$24x + 24 = 10x + 80$$

$$24x - 10x = 80 - 24$$

$$14x = 56$$

$$x = 4$$

So, the age of Meena = $8x = 8 \times 4 = 32$ years

**49.** **(d)** Ratio of the present age of Anubha and her mother = 1:2

According to question, $\frac{x+6}{2x+6} = \frac{11}{20}$

$$20x + 120 = 22x + 66$$

$$2x = 54$$

$$x = 27$$

Before 9 years the ratio of Anubha and her mother

$$= \frac{27-9}{27 \times 2 - 9} = \frac{18}{45} = 2:5$$

**50.** **(b)** Let, the age of Tina and Rakesh is $9x$ and $10x$.

$$\frac{9x-10}{10x-10} = \frac{4}{5}$$

$$45x - 50 = 40x - 40$$

$$5x = 10$$

$x = 2$

$\therefore$ Present age of Rakesh

$= 10x = 10 \times 2 = 20$ years

**51.** **(d)** Let, unmarried women workers are $x$, then as per question,

$$\frac{16\times8+22\times(10+x)}{16+10+x} = 15$$

$\Rightarrow$ $128 + 220 + 22x = 390 + 15x$

$\Rightarrow$ $7x = 42$

$\therefore$ $x = 6$

**52.** **(d)** Let, present age of son is $x$ years and then present age of father is $3x$ years then,

$5(x + 5) = 2(3x + 5)$

$\Rightarrow$ $5x + 25 = 6x + 10$

$\therefore$ $x = 15$ years

Present age of father

= 45 years.

**53.** **(b)** Let, the age of the daughter be $x$.

Then, age of brother

$= x + 5$ years

Therefore, age of mother

$= 2x$ years

$\therefore$ $2x - 20 = x + 5$

$\Rightarrow$ $2x - x = 5 + 20$

$\Rightarrow$ $x = 25$ years.

Age of mother $= 2x$

$= 2 \times 25 = 50$ years

Age of father $= 50 + 10 = 60$ years

**54.** **(b)** Let, the age of Ram and Rahim 10 years ago be $x$ and $3x$ years respectively. Ages of Ram and Rahim after 5 years from now,

$$\frac{x+15}{3x+15} = \frac{2}{3}$$

$\Rightarrow$ $2(3x + 15) = 3(x + 15)$

$\Rightarrow$ $6x + 30 = 3x + 45$

$\Rightarrow$ $6x - 3x = 45 - 30$

$\Rightarrow$ $3x = 15$

$\Rightarrow$ $x = \frac{15}{3} = 5$ years

**55.** **(c)** Total increase $= 11 \times 2 = 22$ months

Therefore, sum of the ages of both cricketers $= (18 + 20)$ years 22 months = 38 years 22 months

Hence, Average age = 19 years 11 months

**56.** **(a)** Shan's age = 55 years

Sathian's age $= 50 - 5$

= 50 years

Balan's age $= 50 - 6 = 44$ years

Devan's age $= 44 - 7 = 37$ years

Difference between Shan's age and Devan's age $= 55 - 37 = 18$ years

**57.** **(c)** Let, the present age of the son be $x$ years.

Therefore, the present age of the father $= 4x$ years

According to the question $x + 3 = 15$ years

Therefore, as $x = 15 - 3 = 12$ years

Hence, the present age of the father $= 4x$

$= 4 \times 12 = 48$ years

**58.** **(d)** Increase in ages of five members in 3 years $= (3 \times 5)$ years = 15 years

Since the average age remains same, therefore, required difference = 15 years

**59.** **(d)** Let, A's present age be $x$ and B's present age be $y$.

Now, according to the question

$$\frac{x-7}{y-7} = \frac{4}{5} \qquad \ldots(1)$$

$$\frac{x+7}{y+7} = \frac{5}{6} \qquad \ldots(2)$$

Above equations become

$5x - 4y = 74$ …(3)

$6x - 5y = -7$ …(4)

On solving these equations, we get $x = 63$ and $y = 77$

$\therefore$ B's present age = 77 years.

**60.** **(c)** Let, the present age of A be $7x$ years and that of B be $9x$ years.

Now, 6 years ago, $\frac{3(7x-6)}{3(9x-6)} = \frac{1}{2}$

or, $42x - 36 = 27x - 18$

or, $15x = 18$

$\therefore$ $x = \frac{6}{5}$ years

Ratio after 6 years

$$\frac{\frac{7\times6}{5}+6}{9\times\frac{6}{5}+6} = \frac{42+30}{54+30} = \frac{72}{84} = 6:7$$

$\therefore$ Required ratio = 6:7

**61.** **(c)** Kapil's present age $= (8 + 5) = 13$ years

Kapil's age after 6 years $=13 + 6=19$ years

Now, Romila's father's age $= 2 \times$Kapil's age $= 2 \times 19 = 36$ years

Father's present age $= 38 - 6 = 32$ years

Romila's present age $= \frac{1}{4}\times$ father's present age $= \frac{1}{4}\times32 = 8$ years

**62.** **(a)** There are four members in a family. Five years ago the sum of ages of the family members = 94 years

Now, sum of present ages of family members $= 94 + 5 \times 4 = 114$ years

∴ Daughter is replaced by daughter-in-law.

Thus, sum of family member's ages becomes 92 years.

∴ Difference = 114 − 92 = 22 years

**63.** **(e)** Parineeta's present age = (33 − 9) = 24 years

∴ Manisha's present age = (24 − 9) = 15 years

∴ Deepali's present age = 15 + 24 = 39 years

∴ Ratio of the present age of Manisha and Deepali = 15:39 = 5:13

∴ X = 13

**64.** **(c)** Let the son's present age be $x$ years. Then the father's present age is $(x + 30)$ years.

Father's age after 10 years = $(x + 40)$ years

Son's age after 10 years = $(x + 10)$ years

According to question:

$(x + 40) = 3(x + 10)$

$\Rightarrow x + 40 = 3x + 30$

$\Rightarrow 2x = 10$

$\therefore x = 5$

**65.** **(a)** Present age of Rehana = 85 − 7 = 78 years

Present age of Wasim = 78 − 12 = 66 years

Present age of Manoj $= \frac{3}{11} \times 66 = 18$ years

Present age of Manoj's father = 18 + 25 = 43 years

**66.** **(c)** Let, Raman's present age be $x$ years.

∴ his daughter's present age $= \frac{x}{3}$ years

His mother's present age $= \frac{13x}{9}$ years

Now, according to the question,

$$x + \frac{x}{3} + \frac{13x}{9} = 125$$

$$\Rightarrow \frac{9x + 3x + 13x}{9} = 125$$

$$\Rightarrow 25x = 125 \times 9$$

$$\Rightarrow x = \frac{125 \times 9}{25} = 45$$

∴ Required difference $= \frac{13x}{9} - \frac{x}{3} = \frac{13x - 3x}{9} = \frac{10x}{9}$

$= \frac{10}{9} \times 45 = 50$ years.

**67.** (c) Let, the present age of Ram and Rakesh be $6x$ and $11x$ years respectively. According to question,

$$\frac{6x - 4}{11x - 4} = \frac{1}{2}$$

$$\Rightarrow 12x - 8 = 11x - 4$$

$$\therefore x = 8 - 4 = 4$$

∴ present age of Rakesh = 11 × 4 = 44 years

After five years, Rakesh's age = 49 years

**68.** **(e)** Let, the present ages of Raj and Radha be $4x$ and $9x$.

Then, according to the question,

$9x = 2(9x - 12) - 3 \Rightarrow 9x = 27 \Rightarrow x = 3$ years

Raj's present age = $4x$ = 12 years

After 5 years, Raj's age will be 12 + 5 = 17 years

**69.** **(d)**

**70.** **(b)** Let, the ages of Tina and Rakesh be $9x$ and $10x$ respectively.

Then, $\frac{9x - 10}{10x - 10} = \frac{4}{5}$

$$\Rightarrow 45x - 40x = 50 - 40$$

$$\Rightarrow x = \frac{10}{5} = 2$$

Rakesh's present age = $10x$ = 10 × 2 = 20 years.

**71.** **(a)** Given M = 8D

M→ Age of Meena

D→ Age of her daughter

Also, $\frac{8D + 8}{D + 8} = \frac{10}{3}$. Solving, we get D = 4

Meena's present age = 8D = 8 × 4 = 32 years

**72.** (a) Let, their present ages be $5x$ and $6x$ respectively.

Then, $\frac{5x + 8}{6x + 8} = \frac{7}{8} \Rightarrow (42 - 40)x = (64 - 56)$

$$\Rightarrow x = \frac{8}{2} = 4$$

Difference in their present ages = $6x - 5x = x$ = 4 years.

**73.** **(b)** $\frac{32 \times 14 + 28 \times 13}{60} = \frac{812}{60} = 13.53$

**74.** **(c)** The two equations are

$$x - 4 = \frac{3}{4}(y - 4);$$

$$x + 4 = \frac{5}{6}(y + 4);$$

$x$→Shyam's present age

$y$→ Ram's present age

# Simple Interest

# 17

## INTRODUCTION

When a person A borrows some money from another person B, then A has to pay certain amount to B in exchange of using the money. This amount paid by A is called *Interest*. The total amount of money borrowed by A from B is called the *Principal*. The money paid back to B, which comprises the principal and the interest is called the *Amount.*

In other words,

$$\text{Amount} = \text{Principal} + \text{Interest}$$

The interest is usually charged according to a specified term, which is expressed as some per cent of the principal and is called the *rate of interest* for a fixed period of time. This fixed period may be a year, six months, three months or a month, and correspondingly the rate of interest is charged annually, semi-annually, quarterly or monthly basis. For Examinationple, the rate of interest is 5% per annum means, the interest payable on ₹100 for one year is ₹5.

Interest is of two types:

1. Simple Interest
2. Compound Interest

## SIMPLE INTEREST

When interest is payable on the principal amount only, it is called *Simple interest*. For example, simple interest on ₹100 at 5% per annum will be ₹5 each year, that is, at the end of the first year, total amount will be ₹105. At the end of the second year, it will be ₹110, and so on.

Thus, simple interest is the interest computed on the principal amount for the entire period it is borrowed.

In this chapter, we shall limit ourselves to simple interest. Compound interest will be discussed in the next chapter.

## SOME BASIC FORMULAE

If $P$ stands for principal, $R$ is the rate per cent per annum, $T$ is the number of years, $I$ is the simple interest and $A$ is the amount, then

1. Simple Interest = $\dfrac{\text{Principal} \times \text{Rate} \times \text{Time}}{100}$

   or, $I = \dfrac{P \times R \times T}{100}$

2. Principal = $\dfrac{100 \times \text{Simple Interest}}{\text{Rate} \times \text{Time}}$

   or, $P = \dfrac{100 \times I}{R \times T}$

**Illustration 1:** Find the simple interest on ₹5200 for 2 years at 6% per annum.

**Solution:** Here, $P$ = ₹5200, $T$ = 2 years and $R$ = 6%

$\therefore$ Simple interest = $\dfrac{P \times R \times T}{100} = \dfrac{5200 \times 6 \times 2}{100}$

= ₹624.

**Illustration 2:** A man earns ₹450 as interest in 2 years on a certain sum of money invested in a company at the rate of 12 per cent per annum. Find the sum invested by the man in the company.

**Solution:** We have, $I$ = ₹450, $T$ = 2 years,

$R$ = 12% per annum

$\therefore$ $P = \dfrac{I \times 100}{R \times T} = \dfrac{450 \times 100}{12 \times 2}$ = ₹1875.

Thus, the money invested by the man was ₹1875.

3. Rate $= \dfrac{100 \times \text{Simple Interest}}{\text{Principal} \times \text{Time}}$

or $R = \dfrac{100 \times I}{P \times T}$

**Illustration 3:** At what interest rate per annum, in 4 years, a sum of ₹5000 will become ₹6000?

**Solution:** Here, $P$ = ₹5000, $A$ = ₹6000, $T$ = 4 years

So, $I = A - P$ = ₹(6000 − 5000) = ₹1000

$\therefore \quad R = \dfrac{100 \times I}{P \times T} = \dfrac{100 \times 1000}{5000 \times 4} = 5\%$

4. Time $= \dfrac{100 \times \text{Simple Interest}}{\text{Rate} \times \text{Principal}}$

or, $T = \dfrac{100 \times I}{R \times P}$

**Illustration 4:** In what time ₹1200 will earn an interest of ₹240 at 5% per annum?

**Solution:** Here, $P$ = ₹1200, $I$ = ₹240, $R$ = 5%

$\therefore \quad T = \dfrac{100 \times I}{R \times P} = \dfrac{100 \times 240}{1200 \times 5} = 4$ years.

5. Amount = Principal + Simple Interest

$= \text{Principal} + \dfrac{\text{Principal} \times \text{Rate} \times \text{Time}}{100}$

$= \text{Principal} \left(1 + \dfrac{\text{Rate} \times \text{Time}}{100}\right)$

or, $\quad A = P\left(1 + \dfrac{R \times T}{100}\right)$

**Illustration 5:** Mahesh borrowed ₹3000 from his friend Suresh at 15 per cent per annum for 3 years. Find the interest and money returned by Mahesh to Suresh.

**Solution:** Here, $P$ = ₹3000, $R$ = 15% per annum, $T$ = 3 years

$\therefore \quad I = \dfrac{P \times R \times T}{100} = \dfrac{3000 \times 15 \times 3}{100}$ = ₹1350.

$\therefore \quad A = P + I$ = ₹3000 + ₹1350 = ₹4350.

Thus, Mahesh paid ₹1350 as interest to Suresh, the total amount Mahesh returned to Suresh = ₹4350.

## SOME USEFUL SHORT CUT METHODS

1. If a certain sum in $T$ years at $R$% per annum amounts to ₹$A$, then the sum will be

$$P = \frac{100 \times A}{100 + R \times T}$$

**Explanation**

Let the principal be ₹$x$

$\therefore$ Simple interest = ₹$(A - x)$

$\therefore \quad A - x = \dfrac{x \times R \times T}{100}$

$\Rightarrow \quad 100A - 100x = xRT$

$\Rightarrow \quad (100 + RT)x = 100A$

$\therefore \quad x = \dfrac{100 \times A}{100 + R \times T}$.

**Illustration 6:** What principal will amount to ₹570 at 4% per annum in $3\frac{1}{2}$ years?

**Solution:** We have, $A$ = ₹570, $R$ = 4% per annum, $T = \dfrac{7}{2}$ years.

$\therefore \quad P = \dfrac{100 \times A}{100 + R \times T} = \dfrac{100 \times 570}{100 + 4 \times 7/2}$

$= \dfrac{100 \times 570}{114}$ = ₹500

Thus, ₹500 will be ₹570 at 4% per annum in $3\frac{1}{2}$ years.

2. The annual payment that will discharge a debt of ₹$A$ due in $T$ years at $R$% per annum is

$$\text{Annual payment} = ₹\left(\frac{100A}{100T + \dfrac{RT(T-1)}{2}}\right)$$

**Explanation**

Let the annual payment be ₹$x$.

Since the first instalment is paid at the end of the first year,

$\therefore$ Amount of the first instalment at the end of $t$ years

$$= x + \frac{(T-1) \times R \times x}{100}$$

Similarly, amount of the second instalment at the end of $t$ years

$$= x + \frac{(T-2)\times R\times x}{100}, \text{ and so on.}$$

Thus, total amount of $T$ instalments

$$A = \left[x + \frac{(T-1)\times R\times x}{100}\right] + \left[x + \frac{(T-2)\times R\times x}{100}\right] + \cdots + x$$

$$= Tx + \frac{Rx}{100}[(T-1)+(T-2)+\cdots+1]$$

$$= Tx + \frac{Rx}{100}\left[\frac{(T-1)\times T}{2}\right]$$

or, $\quad 100\ Tx + Rx\left[\frac{T(T-1)}{2}\right] = 100A$

or, $\quad x\left[100T + \frac{RT(T-1)}{2}\right] = 100A$

$\therefore \quad x = \dfrac{100A}{100T + \dfrac{RT(T-1)}{2}}.$

**Illustration 7:** Find out the annual instalment that will discharge a debt of ₹12,900 due in 4 years at 5% per annum simple interest.

**Solution:** Here, $A$ = ₹12900, $T$ = 4 years, $R$ = 5% per annum.

$\therefore$ Annual instalment $= \dfrac{100\times A}{100\times T + \dfrac{RT(T-1)}{2}}$

$$= \frac{100\times 12900}{(100\times 4) + \dfrac{5(4-1)\times 4}{2}}$$

$$= \frac{100\times 12900}{400+30} = \frac{100\times 12900}{430}$$

= ₹3000.

3. If a certain sum is invested in $n$ types of investments in such a manner that equal amount is obtained on each investment where interest rates are $R_1, R_2, R_3, \ldots, R_n$ respectively, and time periods are $T_1, T_2, T_3, \ldots, T_n$ respectively, then the ratio in which the amounts are invested is:

$$\frac{1}{100+R_1T_1} : \frac{1}{100+R_2T_2} :$$
$$\frac{1}{100+R_3T_3} : \ldots \frac{1}{100+R_nT_n}.$$

**Explanation**

Let $P_1, P_2, \ldots, P_n$ be invested in $n$ types of investments whose interest rates are $R_1, R_2, \ldots, R_n$ and time periods are $T_1, T_2, \ldots, T_n$.

Then, $\quad P_1 = \dfrac{100\times A}{100+R_1T_1}$

$$P_2 = \frac{100\times A}{100+R_2T_2}$$

$$\vdots \qquad \vdots$$

$$P_n = \left(\frac{100\times A}{100+R_nT_n}\right).$$

$\therefore \quad P_1 : P_2 : \ldots : P_n$

$$= \frac{100\times A}{100+R_1T_1} : \frac{100\times A}{100+R_2T_2} : \ldots \frac{100\times A}{100+R_nT_n}$$

$$= \frac{1}{100+R_1T_1} : \frac{1}{100+R_2T_2} : \ldots \frac{1}{100+R_nT_n}$$

[$\because$ the amount $A$ remains same for all]

**Illustration 8:** A sum of ₹1586 is divided among three such parts that amount obtained on these three parts of money after 2, 3 and 4 years, respectively, at the rate of 5% per annum remains equal. Find out such three parts of the sum.

**Solution:** Since the amount accured from each of the three parts of ₹1586 at the rate of 5% p.a. in 2, 3 and 4 years, respectively, remains equal, such three parts of ₹1586 will be in the ratio of

$$\frac{1}{100+R_1T_1} : \frac{1}{100+R_2T_2} : \frac{1}{100+R_3T_3}$$

Hence, the ratio is

$$= \frac{1}{100+5\times 2} : \frac{1}{100+5\times 3} : \frac{1}{100+5\times 4}$$

$$= \frac{1}{110} : \frac{1}{115} : \frac{1}{120}$$

$$= \frac{1\times 30360}{110} : \frac{1\times 30360}{115} : \frac{1\times 30360}{120}$$

($\because$ L.C.M. of 110, 115 and 120 is 30360)

$\therefore \quad$ Ratio = 276:264:253

Sum of proportionals = 276 + 264 + 253 = 793

$\therefore \quad$ 1st part $= \dfrac{276}{793}\times 1586$ = ₹552,

2nd part $= \dfrac{264}{793}\times 1586$ = ₹528

and, 3rd part $= \dfrac{253}{793}\times 1586$ = ₹506.

4. If a certain sum of money becomes $n$ times itself in $T$ years at simple interest, then the rate of interest per annum is

$$R = \frac{100(n-1)}{T}\ \%$$

**Explanation**

Let, ₹$P$ become ₹$nP$ in $t$ years.

$\therefore$ Simple interest $I$ is given by

$$I = nP - P = (n-1)P$$

$\therefore$ Rate of interest $R$ is given by

$$R = \frac{100\times I}{P\times T} = \frac{100\times(n-1)P}{P\times T} = \frac{100(n-1)}{T}.$$

**Illustration 9:** A certain sum of money trebles itself in 5 years simple interest. Find the rate per cent per annum.

**Solution:** Here, $n = 3$, $T = 5$ years

$$\therefore\quad R = \frac{100(n-1)}{T}\% = \frac{100(3-1)}{5}\% = 40\%$$

5. If a certain sum of money becomes $n$ times itself at $R$% per annum simple interest in $T$ years, then

$$T = \left(\frac{n-1}{R}\right)\times 100 \text{ years.}$$

**Illustration 10:** In what time a sum of money will double itself at a rate of simple interest of 8% p.a.?

**Solution:** Required time $(T) = \dfrac{(n-1)\times 100}{R}$ years

$$= \frac{(2-1)\times 100}{8} \text{ years}$$

$$= 12\frac{1}{2} \text{ years.}$$

6. If a certain sum of money becomes $n$ times itself in $T$ years at a simple interest, then the time $T'$ in which it will become $m$ times itself is given by

$$T' = \left(\frac{m-1}{n-1}\right)\times T \text{ years.}$$

**Explanation**

Let the principal be ₹$P$.

Let it become $m$ times in $T'$ years.

Then, the amount in $T$ years = ₹$nP$

and the amount in $T'$ years = ₹$mP$.

$$\therefore\quad nP - P = \frac{P\times R\times T}{100}$$

$$\text{or,}\quad (n-1)P = \frac{P\times R\times T}{100} \qquad \cdots(1)$$

$$\text{and,}\quad (m-1)P = \frac{P\times R\times T}{100} \qquad \cdots(2)$$

$$\therefore\quad \frac{(m-1)P}{(n-1)P} = \frac{P\times R\times T'}{100}\times\frac{100}{P\times R\times T}$$

$$\text{or,}\quad \frac{m-1}{n-1} = \frac{T'}{T}$$

$$\therefore\quad T' = \left(\frac{m-1}{n-1}\right) T \text{ years.}$$

**Illustration 11:** A sum of money put out on simple interest doubles itself in $12\frac{1}{2}$ years. In how many years would it treble itself?

**Solution:** Here, $n = 2$, $m = 3$, $T = \dfrac{25}{2}$ years.

$$\therefore\quad \text{Required time } (T') = \left(\frac{m-1}{n-1}\right)\times T \text{ years}$$

$$= \left(\frac{3-1}{2-1}\right)\times\frac{25}{2} \text{ years}$$

$$= 25 \text{ years.}$$

7. Effect of change of $P$, $R$ and $T$ on simple interest is given by the following formula:

Change in Simple Interest

$$= \frac{\text{Product of fixed parameter}}{100}$$

$\times$ [difference of product of variable parameters]

For example, if rate $(R)$ changes from $R_1$ to $R_2$ and $P$, $T$ are fixed, then

$$\text{Change in SI} = \frac{PT}{100}\times(R_1 - R_2)$$

Similarly, if principal $(P)$ changes from $P_1$ to $P_2$ and $R$, $T$ are fixed, then change in SI = $\dfrac{RT}{100}\times(P_1 - P_2)$

Also, if rate $(R)$ changes from $R_1$ to $R_2$ and time $(T)$ changes from $T_1$ to $T_2$, but principal $(P)$ is fixed, then change in SI = $\dfrac{P}{100}\times(R_1T_1 - R_2T_2)$.

**Illustration 12:** If simple interest on ₹600 increases by ₹30, when the rate % increases by 4% per annum, find out the time.

**Solution:** Here, $P$ = 600, change in SI = 30, $R_1 - R_2$ = 4, $T$ = ?

Using, change in SI = $\frac{PT}{100} \times (R_1 - R_2)$

we have, 30 = $\frac{600T}{100} \times 4$

$\Rightarrow \quad T = \frac{5}{4}$, i.e., $1\frac{1}{4}$ years.

**Illustration 13:** If the simple interest on ₹1400 be more than the interest on ₹1000 by ₹60 in 5 years, find the out the rate per cent per annum.

**Solution:** Here, change in SI = 60, $P_1 - P_2$ = 400, $T$ = 5, $R$ = ?

Using change in SI = $\frac{RT}{100} \times (P_1 - P_2)$

We have, 60 = $\frac{5R}{100} \times 400 \quad \Rightarrow \quad R = 3\%$

**Illustration 14:** If the simple interest on a certain sum at 4% per annum for 4 years is ₹80 more than the interest on the same sum for 3 years at 5% per annum, find out the sum.

**Solution:** Here, change in SI = 80, $R_1$ = 4, $R_2$ = 5, $T_1$ = 4, $T_2$ = 3, $P$ = ?

Using change in SI = $\frac{P}{100} \times (R_1T_1 - R_2T_2)$

We have, 80 = $\frac{P}{100}$ × (4 × 4 –5 × 3)

$\Rightarrow \quad P$ = ₹8000.

8. If a debt of ₹$Z$ is paid in '$n$' number of instalments and if the value of each instalment is ₹$a$, then the borrowed (debt) amount is given by

$$Z = na + \frac{Ra}{100 \times b} \times \frac{n(n-1)}{2}$$

where, $R$ = rate of interest per annum
$b$ = number of instalments/year
$b$ = 1, when each instalment is paid yearly
$b$ = 2, when each instalment is paid half-yearly
$b$ = 4, when each instalment is paid quarterly
$b$ = 12, when each instalment is paid monthly.

**Illustration 15:** A sum of ₹2 is lent to be paid back in 3 equal monthly instalments of ₹1 each. Find the rate per cent.

**Solution:** Here, $Z$ = ₹2, $a$ = ₹1, $n$ = 3, $b$ = 12, $R$ = ?
Using the formula

$$Z = na + \frac{Ra}{100 \times b} \times \frac{n(n-1)}{2},$$

we have, $2 = 3 \times 1 + \frac{R \times 1}{100 \times 12} \times \frac{3 \times 2}{2} \quad \Rightarrow \quad R = 400\%$

$\therefore$ The rate % p.a. is 400%

9. If a certain sum of money $P$ lent out at SI amounts to $A_1$ in $T_1$ years and to $A_2$ in $T_2$ years, then

$$P = \frac{A_1T_2 - A_2T_1}{T_2 - T_1}$$

and, $$R = \frac{A_1 - A_2}{A_1T_2 - A_2T_1} \times 100\%$$

**Illustration 16:** If a certain sum of money at simple interest amounts to ₹5184 in 2 years and to ₹5832 in 3 years, what is the sum and the rate of interest?

**Solution:** Principal = $\frac{A_1T_2 - A_2T_1}{T_2 - T_1}$

$$\begin{bmatrix} \text{Here, } A_1 = 5184, A_2 = 5832 \\ T_1 = 2, T_2 = 3 \end{bmatrix}$$

$$= \frac{5184 \times 3 - 5832 \times 2}{3 - 2} = ₹3888$$

and, Rate = $\frac{(A_2 - A_1) \times 100}{T_1A_2 - T_2A_1} = \frac{(5832 - 5184) \times 100}{2 \times 5832 - 3 \times 5184}$

$$= \frac{64800}{3888} = 16\frac{2}{3}\%$$

10. If a certain sum of money $P$ lent out for a certain time $T$ amounts to $A_1$ at $R_1$% per annum and to $A_2$ at $R_2$% per annum, then

$$P = \frac{A_2R_1 - A_1R_2}{R_1 - R_2}$$

and, $T = \frac{A_1 - A_2}{A_2R_1 - A_1R_2} \times 100$ years.

**Illustration 17:** A certain sum is invested for certain time. It amounts to ₹450 at 7% per annum. But, when invested at 5% per annum, it amounts to ₹350. Find out the sum and time.

**Solution:** Here, $A_1 = 450$, $R_1 = 7$, $A_2 = 350$, $R_2 = 5$.
Using the formula,

$$P = \frac{A_2R_1 - A_1R_2}{R_1 - R_2}$$

We get, $P = \dfrac{350\times 7 - 450\times 5}{7-5} = ₹100$

Also, using the formula,

$$T = \left(\frac{A_1 - A_2}{A_2R_1 - A_1R_2}\right) \times 100$$

we get, $T = \left(\dfrac{450 - 350}{350\times 7 - 450\times 5}\right)\times 100 = 5$ years.

> 11. If an amount $P_1$ lent at simple interest rate of $R_1$% per annum, and another amount $P_2$ at simple interest rate of $R_2$% per annum, then the rate of interest for the whole sum is
>
> $$R = \left(\frac{P_1R_1 + P_2R_2}{P_1 + P_2}\right).$$

**Illustration 18:** Mohan deposits ₹5000 in NSC at 2% per annum and ₹2000 in mutual funds at 4% per annum. Find out the rate of interest for the whole sum.

**Solution:** Here, $P_1 = 5000$, $R_1 = 2$, $P_2 = 2000$, $R_2 = 4$.
Using the formula

$$R = \left(\frac{P_1R_1 + P_2R_2}{P_1 + P_2}\right)$$

We get, $R = \dfrac{5000\times 2 + 2000\times 4}{5000 + 2000} = 2\dfrac{4}{7}$ %

> 12. If a certain sum of money is lent out in $n$ parts in such a manner that equal sum of money is obtained as simple interest on each part where interest rates are $R_1, R_2, ..., R_n$ and time periods are $T_1, T_2, ..., T_n$, respectively, then the ratio in which the sum will be divided in $n$ parts is given by
>
> $$\frac{1}{R_1T_1} : \frac{1}{R_2T_2} : ... \frac{1}{R_nT_n}.$$

**Explanation**

Let the $n$ equal parts be $P_1, P_2, ..., P_n$ and, let $I$ be the equal interest earned on each part.

Then, $P_1 = \dfrac{I\times 100}{R_1T_1}$

$P_2 = \dfrac{I\times 100}{R_2T_2}$

$\vdots \qquad \vdots$

$P_n = \dfrac{I\times 100}{R_nT_n}$.

$\therefore \quad P_1:P_2: ... :P_n = \dfrac{I\times 100}{R_1T_1} : \dfrac{I\times 100}{R_2T_2} : ... \dfrac{I\times 100}{R_nT_n}$

$= \dfrac{1}{R_1T_1} : \dfrac{1}{R_2T_2} : ... \dfrac{1}{R_nT_n}$.

**Illustration 19:** If a sum of ₹1600 is divided into two such parts that the simple interest on the first part for $2\frac{1}{2}$ years at the rate of 4% p.a. equals the simple interest on the second part for 5 years at the rate of 3% p.a., then find two such divisions of the sum.

**Solution:** Ratio of one part to other part of ₹1600

$$= \frac{1}{R_1T_1} : \frac{1}{R_2T_2}$$

$\therefore \quad$ 1st part:2nd part $= \dfrac{1}{4\times \frac{5}{2}} : \dfrac{1}{3\times 5}$

[Here, $R_1 = 4\%$ p.a., $T_1 = \dfrac{5}{2}$ years, $R_2 = 3\%$ p.a., $T_2 = 5$ years]

or, 1st part:2nd part $= \dfrac{1}{10} : \dfrac{1}{15} = 3:2$

Sum of proportionals = 3 + 2 = 5

$\therefore \quad$ 1st part $= \dfrac{3}{5}\times 1600 = ₹96$

and, 2nd part $= \dfrac{2}{5}\times 1600 = ₹640$.

> 13. When there is a change in principal ($P$), Rate ($R$) and Time ($T$), then the value of simple interest $I$ also changes and is given by
>
> $$\frac{I_1}{I_2} = \frac{P_1\times R_1\times T_1}{P_2\times R_2\times T_2}$$
>
> $$\Rightarrow \quad \frac{A_1 - P_1}{A_2 - P_2} = \frac{P_1\times R_1\times T_1}{P_2\times R_2\times T_2}$$
>
> as $I_1 = A_1 - P_1$ and $I_2 = A_2 - P_2$.

**Illustration 20:** If ₹85 amounts to ₹95 in 3 years, what ₹102 will amount to in 5 years at the same rate per cent?

**Solution:** Here, $P_1$ = ₹85, $A_1$ = ₹95, $T_1$ = 3 years, $P_2$ = ₹102, $T_2$ = 5 years, $R_1 = R_2 = R$ (say).

Then, using the formula

$$\frac{A_1 - P_1}{A_2 - P_2} = \frac{P_1 \times R_1 \times T_1}{P_2 \times R_2 \times T_2}$$

We have, $\dfrac{95-85}{A_2 - 102} = \dfrac{85 \times R \times 3}{102 \times R \times 5}$

$\Rightarrow \quad A_2 - 102 = 20$

$\Rightarrow \quad A_2 = 122$

$\therefore$ The amount is ₹122.

14. Out of a certain sum $P$, $\frac{1}{a}$ part is invested at $R_1\%$, $\frac{1}{b}$ part at $R_2\%$ and the remainder $\left(1 - \frac{1}{a} - \frac{1}{b}\right)$ say $\frac{1}{c}$ part at $R_3\%$. If the annual income from all these investments is ₹$A$, then the original sum is given by

$$P = \left(\frac{A \times 100}{\frac{R_1}{a} + \frac{R_2}{b} + \frac{R_3}{c}}\right).$$

**Illustration 21:** Out of a certain sum, $\frac{1}{3}$ is invested at 3%, $\frac{1}{6}$ at 6% and the rest at 8%. If the annual income is ₹300, then the original sum is

**Solution:** Here,

$$\frac{1}{a} = \frac{1}{3}, \frac{1}{b} = \frac{1}{6},$$

$$\frac{1}{c} = 1 - \left(\frac{1}{3} + \frac{1}{6}\right) = \frac{1}{2},$$

$R_1 = 3\%$, $R_2 = 6\%$, $R_3 = 8\%$,

$A = ₹300$.

$$\therefore \quad \text{The original sum} = \frac{A \times 100}{\frac{R_1}{a} + \frac{R_2}{b} + \frac{R_3}{c}}$$

$$= \frac{300 \times 100}{\frac{3}{3} + \frac{6}{6} + \frac{8}{2}} = \frac{30000}{6}$$

= ₹5000.

## Exercise-I

**1.** The simple interest on ₹500 at 6% per annum from May 3rd to July 15th in the same year is:

(a) ₹9 (b) ₹6
(c) ₹4 (d) None of these

**2.** Mr Irani borrowed a sum of ₹10000 from a finance company for 6 years at 8% per annum. The amount returned by Mr Irani to the finance company is:

(a) ₹14800 (b) ₹12600
(c) ₹13300 (d) None of these

**3.** The principal that will yield ₹60 as simple interest at 6% per annum in 5 years is:

(a) ₹175 (b) ₹350
(c) ₹200 (d) None of these

**4.** The sum of money that will produce ₹1770 interest in $7\frac{1}{2}$ years at 8% simple interest per annum is:

(a) ₹2950 (b) ₹3120
(c) ₹2800 (d) None of these

**5.** If the simple interest on a certain sum of money after $6\frac{1}{4}$ years is 3/8 of the principal, then the rate of interest per annum is:

(a) 5% (b) 6%
(c) 4% (d) None of these

**6.** Rakesh borrowed ₹5000 from Ganesh at simple interest. If Ganesh received ₹500 more than his capital after 5 years, then the rate of interest per annum is:

(a) 2% (b) 3%
(c) 4% (d) None of these

**7.** The rate per cent per annum at which ₹1200 amount to ₹1440 in 4 years, is:

(a) 5% (b) 4%
(c) 6% (d) None of these

**8.** If simple interest on a certain sum of money is ₹256 and the rate of interest per annum equals the number of years, then the rate of interest is:

(a) 13% (b) 14%
(c) 16% (d) None of these

**9.** If the simple interest on a certain sum of money for 2 years is one-fifth of the sum, then the rate of interest per annum is:

(a) 9% (b) 10%
(c) 8% (d) None of these

**10.** If the simple interest on a certain sum of money is $\frac{4}{25}$ of the sum and the rate per cent equals the number of years, then the rate of interest per annum is:

(a) 2% (b) 3%
(c) 4% (d) None of these

**11.** If a certain sum of money borrowed at 5% per annum simple interest amounts to ₹1020 in 4 years, then the sum of money borrowed is:

(a) ₹850 (b) ₹925
(c) ₹750 (d) None of these

**12.** In what time ₹1200 will become ₹1344 at 6% per annum?

(a) $2\frac{1}{2}$ years (b) 3 years
(c) 2 years (d) None of these

**13.** In what time ₹8100 will produce the same income at 3% as ₹225 in 4 years at 3%.

(a) $\frac{1}{7}$ years (b) $\frac{1}{9}$ years
(c) $\frac{1}{6}$ years (d) None of these

**14.** If ₹1000 be invested at interest rate of 5% and the interest be added to the principal every 10 years, then the number of years in which it will amount to ₹2000 is:

(a) $16\frac{2}{3}$ years (b) $16\frac{1}{4}$ years
(c) 16 years (d) None of these

**15.** If ₹500 amounts to ₹725 at 9% simple interest in some time, what will ₹600 amount to at 11% in the same time?

(a) ₹870 (b) ₹930
(c) ₹910 (d) None of these

**16.** Sumit lends ₹10000 for 2 years at 20% per annum simple interest. After 1 year, he receives ₹6000. How much will he receive next year?

(a) ₹5900 (b) ₹6400
(c) ₹7200 (d) None of these

**17.** What principal will amount to ₹15000 at 10% per annum in 5 years?

(a) ₹10000 (b) ₹8700
(c) ₹10500 (d) None of these

**18.** The annual payment that will discharge a debt of ₹47250 due 3 years, hence at the rate of 5% simple interest is:

(a) ₹8000 (b) ₹10000
(c) ₹15000 (d) None of these

**19.** The annual instalment that will discharge a debt of ₹4200 due in 5 years at 10% simple interest is:

(a) ₹700 (b) ₹750
(c) ₹800 (d) None of these

**20.** If the amount obtained by Mahesh by investing ₹1500 for $2\frac{1}{2}$ years at the rate of 8% p.a. is equal to the amount obtained by Suresh by investing a certain sum for 2 years at 5% p.a. simple interest, then the sum invested by Suresh is:

(a) ₹$1636\frac{4}{11}$ (b) ₹1636
(c) ₹$1636\frac{1}{2}$ (d) None of these

**21.** A man invests ₹3965 in the names of his three daughters, Neeta, Sita and Gita in such a way that they would receive the same amount after 2, 3 and 4 years. If the rate of interest is 5% p.a., then the amount invested for Neeta, Sita and Gita is:

(a) ₹1380, ₹1320, ₹1265
(b) ₹1330, ₹1360, ₹1380
(c) ₹1265, ₹1320, ₹1340
(d) None of these

**22.** A sum of money at simple interest becomes four times in 24 years. The rate per cent of interest per annum is:

(a) $13\frac{3}{4}$% (b) $12\frac{1}{2}$%
(c) $11\frac{3}{4}$% (d) None of these

**23.** In how many years will a sum of money treble itself at 10% per annum simple interest?

(a) 15 years (b) 19 years
(c) 20 years (d) None of these

**24.** A sum of money doubles itself in 8 years. In how many years will it treble?

(a) 16 years (b) 15 years
(c) 14 years (d) None of these

**25.** A sum was put at simple interest at a certain rate for 4 years. Had it been put at 2% higher rate, it would have fetched ₹56 more. Find the sum.

(a) ₹680 (b) ₹700
(c) ₹720 (d) None of these

**26.** If the interest on ₹800 be more than the interest on ₹400 by ₹40 in 2 years, then the rate of interest per annum is:

(a) 5% (b) $5\frac{1}{2}\%$

(c) 6% (d) None of these

**27.** If the difference between the simple interest on a certain sum for 4 years at $2\frac{1}{2}\%$ per annum and the simple interest on the same sum for the same period at 3% per annum is ₹60, then the sum is:

(a) ₹3000 (b) ₹2900
(c) ₹3100 (d) None of these

**28.** If a certain sum of money at simple interest amounts to ₹2800 in 2 years and ₹3250 in 5 years, then the rate of interest per annum is:

(a) 4% (b) 6%
(c) 5% (d) None of these

**29.** If a certain sum of money amounts to ₹1760 in two years and ₹2000 in 5 years at simple interest, then the sum is:

(a) ₹1960 (b) ₹1590
(c) ₹1600 (d) None of these

**30.** A certain sum is invested for certain time. It amounts to ₹450 at 7% per annum. But when invested at 5% per annum, it amounts to ₹350. Find the sum.

(a) ₹60 (b) ₹100
(c) ₹120 (d) None of these

**31.** A certain sum is invested for *T* years. It amounts to ₹400 at 10% per annum. But, when invested at 4% per annum, it amounts to ₹200. Find the time (*T*).

(a) 41 years (b) 39 years
(c) 50 years (d) None of these

**32.** If a sum of ₹9 is lent to be paid back in 10 equal monthly instalments of ₹1 each, then the rate of interest is:

(a) $266\frac{2}{3}\%$ (b) $265\frac{3}{4}\%$

(c) 266% (d) None of these

**33.** A sum of ₹7700 is to be divided among three brothers Vikas, Vijay and Viraj in such a way that simple interest on each part at 5% per annum after 1, 2 and 3 years, remains equal. The share of Vikas is more than that of Viraj by:

(a) ₹2800 (b) ₹2500
(c) ₹3000 (d) None of these

**34.** If simple interest on a certain sum of money for 4 years at 5% p.a. is same as the simple interest on ₹560 for 10 years at the rate of 4% p.a., then the sum of money is:

(a) ₹1190 (b) ₹1120
(c) ₹1210 (d) None of these

**35.** Mr Mani invested an amount of ₹12000 at a simple interest rate of 10% per annum and another amount at a simple interest rate of 20% per annum. The total interest earned at the end of one year on the total amount invested became 14% per annum. Find the total amount invested.

(a) ₹20000 (b) ₹20800
(c) ₹21000 (d) None of these

**36.** Mr Gupta deposits ₹3000 in a bank at 10% per annum and ₹5000 in another bank at 8% per annum. The rate of interest for the whole sum is:

(a) $8\frac{1}{2}\%$ (b) $8\frac{3}{4}\%$

(c) 8% (d) None of these

**37.** A person invested $\frac{2}{3}$ of his capital at 3%, $\frac{1}{6}$ at 6% and the remainder at 12%. If his annual income is ₹25, then the capital is:

(a) ₹490 (b) ₹510
(c) ₹500 (d) None of these

**38.** The simple interest on a sum of money will be ₹600 after 10 years. If the principal is trebled after 5 years, then what will be the total interest at the end of the tenth year?

(a) ₹1200 (b) ₹1190
(c) ₹1210 (d) None of these

**39.** ₹1500 is invested at a rate of 10% simple interest and interest is added to the principal after every 5 years. In how many years will it amount to ₹2500.

(a) $6\frac{1}{9}$ years (b) $6\frac{1}{4}$ years

(c) 7 years (d) None of these

**40.** Sumit lent some money to Mohit at 5% per annum simple interest. Mohit lent the entire amount to Birju on the same day at $8\frac{1}{2}\%$ per annum. In this transaction, after a year Mohit earned a profit of ₹350. Find out the sum of money lent by Sumit to Mohit.

(a) ₹9000 (b) ₹10000
(c) ₹10200 (d) None of these

**41.** Brinda borrowed ₹1000 to build a hut. She pays 5% simple interest. She lets the hut to Ramu and receives a rent of ₹$12\frac{1}{2}$ per month from Ramu. In how many years Brinda would clear off the debt?

(a) 10 years (b) $10\frac{1}{4}$ years
(c) $10\frac{1}{2}$ years (d) None of these

**42.** The rate of interest on a sum of money is 4% per annum for the first 2 years, 6% per annum for the next 4 years, and 8% per annum for the period beyond 6 years. If the simple interest accrued by the sum for a total period of 9 years is ₹1120, then the sum is:
(a) ₹2400 (b) ₹2200
(c) ₹2000 (d) None of these

## Exercise-2
## (Based on Memory)

**1.** The effective annual rate of interest, corresponding to a nominal rate of 6% per annum, payable half yearly, is:
(a) 6.06% (b) 6.07%
(c) 6.08% (d) 6.09%
**[SSC (GL) Prel. Examination, 2005]**

**2.** What annual instalment will discharge a debt of ₹6450 due in 4 years at 5% simple interest?
(a) ₹1650 (b) ₹1835
(c) ₹1935 (d) ₹1950
**[SSC (GL) Prel. Examination, 2005]**

**3.** In what time will ₹72 become ₹81 at $6\frac{1}{4}$% per annum simple interst?
(a) 2 years (b) 3 years
(c) 2 years 6 months (d) None of these
**[SSC (GL) Prel. Examination, 2005]**

**4.** A sum of ₹1500 is lent out in two parts in such a way that the simple interest on one part at 10% per annum for 5 years is equal to that on the second part at 12.5% per annum for 4 years. The sum lent out at 12.5% is
(a) ₹500 (b) ₹1000
(c) ₹750 (d) ₹1250
**[SSC (GL) Prel. Examination, 2005]**

**5.** Veena obtained an amount of ₹8376 as simple interest on a certain amount at 8 per cent p.a. after 6 years. What is the amount invested by Veena?
(a) ₹17180 (b) ₹18110
(c) ₹16660 (d) ₹17450
(e) None of these
**[SBI PO, 2008]**

**6.** Manish borrowed a sum of ₹1150 from Anil at the simple rate of 6 per cent p.a. for 3 years. He then added some more money to the borrowed sum and lent it to Sunil for the same time at 9 per cent p.a. at simple interest. If Manish gains ₹274.95 by way of interest on the borrowed sum as well as his own amount from the whole transaction, then what is the sum lent by him to Sunil?
(a) ₹1290 (b) ₹1785
(c) ₹1285 (d) ₹1200
(e) None of these
**[OBC PO, 2007]**

**7.** What will be the simple interest earned on an amount of ₹988 @ 18 per cent p.a. at the end of 5 years?
(a) ₹711.36 (b) ₹898.23
(c) ₹799.25 (d) ₹805.40
(e) None of these
**[Allahabad Bank PO, 2007]**

**8.** The simple interest in 14 months on a certain sum at the rate of 6% per annum is ₹250 more than the interest on the same sum at the rate of 8% in 8 months. How much amount was borrowed?
(a) ₹15000 (b) ₹25000
(c) ₹7500 (d) ₹14500
(e) None of these
**[BSRB Bangalore PO, 1999]**

**9.** At a simple interest ₹800 becomes ₹956 in three years. If the interest rate is increased by 3%, how much would ₹800 become in three years.
(a) ₹1020.80 (b) ₹1004
(c) ₹1028 (d) Data inadequate
(e) None of these
**[BSRB Delhi PO, 1999]**

**10.** Ankit deposited two parts of a sum of ₹25000 in different banks at the rates of 15% per annum and 18% per annum respectively. In one year he got ₹4050 as the total interest. What was the amount deposited at the rate of 18% per annum?
(a) ₹9000 (b) ₹18000
(c) ₹15000 (d) Data inadequate
(e) None of these
**[BSRB Patna PO, 2001]**

**11.** Mr Kalia invested a total amount of ₹16500 for two years in two schemes A and B with rate of simple interest 10% per annum and 12% per annum, respectively. If the total amount of interest earned was ₹3620, what was amount invested in scheme A?

(a) ₹8000 (b) ₹8600
(c) ₹8150 (d) Data inadequate
(e) None of these

**[Andhra Bank PO, 2002]**

**12.** A sum fetched total simple interest of ₹4016.25 at the rate of 9% per annum in 5 years. What is the sum?

(a) ₹8925 (b) ₹8032.50
(c) ₹4462.50 (d) ₹8900
(e) None of these

**[NABARD Asst. Manager, 2002]**

**13.** A shopkeeper allows two successive discounts of 10% and 20%. If he sells an article for ₹540, then the marked price of the article is:

(a) ₹750 (b) ₹740
(c) ₹725 (d) ₹700

**[SI of Police Rec. Examination, 1997]**

**14.** In how many years will a sum of money double itself at 10% simple interest?

(a) 5 years (b) 6 years
(c) 10 years (d) 20 years

**[SI of Police Rec. Examination, 1997]**

**15.** What is the present worth of ₹132 due in 2 years at 5% simple interest per annum?

(a) ₹120 (b) ₹122
(c) ₹112 (d) ₹118.80

**[SI of Police Rec. Examination, 1997]**

**16.** A sum of ₹5000 was lent partly at 6% and partly at 9% simple interest. If the total interest received after one year was ₹390, the ratio in which the money was lent at 6% and 9% is:

(a) 1:1 (b) 3:2
(c) 2:3 (d) 1:2

**[SI of Police Rec. Examination, 1997]**

**17.** Divide ₹2379 into 3 parts so that their amount after 2, 3 and 4 years, respectively may be equal, the rate of interest being 5% per annum at simple interest. The first part is given by:

(a) ₹828 (b) ₹792
(c) ₹759 (d) ₹818

**[SI Rec. Examination Delhi Police, 1997]**

**18.** The simple interest on a certain sum of money for $2\frac{1}{2}$ years at 12% per annum is ₹40 less than the simple interest on the same sum for $3\frac{1}{2}$ years at 10% per annum. The sum is:

(a) ₹600 (b) ₹800
(c) ₹700 (d) ₹900

**[SI Rec. Examination Delhi Police, 1997]**

**19.** In how much time would the simple interest on a certain sum be 0.125 times the principal at 10% per annum?

(a) $1\frac{1}{4}$ years (b) $1\frac{3}{4}$ years
(c) $2\frac{1}{4}$ years (d) $2\frac{3}{4}$ years

**[Asstt. Grade Examination, 1997]**

**20.** The simple interest on a sum of money is $\frac{1}{4}$ of the principal. If number of years is equal to rate per cent per annum, the interest rate is:

(a) 5.0% (b) 5.1%
(c) 5.2% (d) 4.8%

**[SI of Police Rec. Examination PO, 1998]**

**21.** In how many years a certain sum doubles itself at 4% per annum simple interest?

(a) 5 years (b) 10 years
(c) 20 years (d) 25 years

**[SSC (GL) Prel. Examination, 1999]**

**22.** The difference between the simple interest on a certain sum of money at 6% per annum for 10 years and at 5% per annum for 2 years is ₹100. Find the sum:

(a) ₹100 (b) ₹200
(c) ₹400 (d) ₹500

**[SSC (GL) Prel. Examination, 1999]**

**23.** Two equal sums of money were invested, one at 4% and the other at $4\frac{1}{2}$%. At the end of 7 years, the simple interest received from the latter exceeds to that received from the former by ₹31.50. Each sum was:

(a) ₹1000 (b) ₹500
(c) ₹750 (d) ₹900

**[SSC (GL) Prel. Examination, 1999]**

**24.** The simple interest on a certain sum at 5% per annum for 3 years and 4 years differ by ₹42. The sum is:

(a) ₹210 (b) ₹280
(c) ₹750 (d) ₹840

**[SSC (GL) Prel. Examination, 1999]**

**25.** A sum of ₹1600 gives a simple interest of ₹252 in 2 years and 3 months. The rate of interest per annum is:

(a) $5\frac{1}{2}\%$ (b) 8%

(c) 7% (d) 6%

**[SSC (GL) Prel. Examination, 2000]**

**26.** A sum of ₹400 amounts to ₹480 in 4 years. What will it amount to if the rate of interest is increased by 2%?

(a) ₹484 (b) ₹560

(c) ₹512 (d) None of these

**[SSC (GL) Prel. Examination, 2000]**

**27.** The simple interest on a sum of money is $\frac{4}{9}$ of the principal and the number of years is equal to the rate per cent per annum. The rate per annum is:

(a) 5% (b) $6\frac{2}{3}\%$

(c) 6% (d) $7\frac{1}{5}\%$

**[SSC (GL) Prel. Examination, 2000]**

**28.** ₹1500 were divided into two parts. One part was put at 6% and the other at 5% interest. If the whole annual interest from both investments was ₹85, then the investment at 6% was:

(a) ₹1200 (b) ₹1000

(c) ₹1300 (d) ₹1150

**[Railway Rec. Board Examination, 2000]**

**29.** A person borrows ₹5000 for two years at 4% per annum simple interest. He immediately lends to another person at $6\frac{1}{4}\%$ per annum for 2 years. Find his gain in the transaction per year:

(a) ₹112.50 (b) ₹450.00

(c) ₹244.53 (d) ₹150.00

**[SSC (GL) Prel. Examination, 2000]**

**30.** A sum of ₹1550 was lent partly at 5% and partly at 8% simple interest. The total interest received after 3 year is ₹300. The ratio of money lent at 5% to that at 8%:

(a) 5:8 (b) 8:5

(c) 31:6 (d) 16:5

**[SSC (GL) Prel. Examination, 2002]**

**31.** In what time will the simple interest be $\frac{2}{5}$ of the principal at 8% per annum?

(a) 8 years (b) 7 years

(c) 5 years (d) 6 years

**[SSC (GL) Prel. Examination, 2002]**

**32.** A person lent ₹5,000 partly at the rate of 4% and partly at the rate of 5% per annum simple interest. The total interest after 2 years is ₹440. To find the sum of money lent at each of the above rates, ₹5,000 is to be divided in the ratio:

(a) 4:5 (b) 3:2

(c) 5:4 (d) 2:3

**[SSC (GL) Prel. Examination, 2002]**

**33.** At what rate per cent per annum will the simple interest on a sum of money be $\frac{2}{5}$ of the amount in 10 years?

(a) 4% (b) 6%

(c) $5\frac{2}{3}\%$ (d) $6\frac{2}{3}\%$

**[SSC (GL) Prel. Examination, 2002]**

**34.** If the simple interest on a certain sum for 15 months at $7\frac{1}{2}\%$ per annum exceeds the simple interest on the same sum for 8 months at $12\frac{1}{2}\%$ per annum by ₹32.50, then the sum (in ₹) is:

(a) 312 (b) 312.50

(c) 3120 (d) 3120.50

**[SSC Prel. (L) Examination, 2002]**

**35.** In 4 years, the simple interest on a certain sum of money is $\frac{9}{25}$ of the principal. The annual rate of interest is:

(a) 4% (b) $4\frac{1}{2}\%$

(c) 9% (d) 10%

**[SSC (GL) Prel. Examination, 2002]**

**36.** What sum of money will amount to ₹520 in 5 years and to ₹568 in 7 years at simple interest?

(a) ₹400 (b) ₹120

(c) ₹510 (d) ₹220

**[SSC (GL) Prel. Examination, 2003]**

**37.** A lends ₹2500 to B and a certain sum to C at the same time at 7% annual simple interest. If after 4 years, A altogether receives ₹1120 as interest from B and C, the sum lent to C is:

(a) ₹700 (b) ₹6500

(c) ₹4000 (d) ₹1500

**[SSC (GL) Prel. Examination, 2003]**

**38.** A sum of money becomes $\frac{41}{40}$ of itself in $\frac{1}{4}$ years at a certain rate of simple interest. The rate of interest per annum is:

(a) 10% (b) 1%
(c) 2.5% (d) 5%

**[SSC (GL) Prel. Examination, 2003]**

**39.** A man loses ₹55.50 yearly when the annual rate of interest falls from 11.5 to 10%. His capital (in rupees) is:

(a) 3700 (b) 7400
(c) 8325 (d) 11100

**[SSC (GL) Prel. Examination, 2003]**

**40.** A certain amount earns simple interest of ₹1750 after 7 years. Had the interest been 2% more, how much more interest would it have earned?

(a) ₹35 (b) ₹350
(c) ₹245 (d) Cannot be determined
(e) None of these

**[Canara Bank PO, 2003]**

**41.** Nikhil invested certain amount in three different schemes A, B and C with the rate of interest 10% per annum, 12% per annum and 15% per annum, respectively. If the total interest accrued in one year was ₹3200 and the amount invested in scheme C was 150% of the amount invested in scheme A and 240% of the amount invested in scheme B, what was the amount invested in scheme B?

(a) ₹8000 (b) ₹5000
(c) ₹6500 (d) Cannot be determined
(e) None of these

**[PNB Management Trainee Examination, 2003]**

**42.** The simple interest accrued on a sum of certain principal is ₹1200 in 4 years at the rate of 8% per annum.. What would be the simple interest accrued on thrice of that principal at the rate of 6% per annum in 3 years?

(a) ₹2025 (b) ₹3025
(c) ₹2250 (d) ₹2150

**[OBC PO, 2010]**

**43.** Arun invested a sum of money at a certain rate of simple interest for a period of four years. Had he invested the same sum for a period of six years, the total interest earned by him would have been fifty per cent more than the earlier interest amount? What was the rate of interest per cent per annum?

(a) 4 (b) 8
(c) 5 (d) Cannot be determined

**[Gramin Bank U.P. (SO) Examination, 2012]**

**44.** In what time will a sum of money double itself @ 20% per annum simple interest

(a) 10 years (b) 5 years
(c) 2 years (d) 14 years

**[SSC (GL), 2011]**

**45.** 800 becomes ₹956 in 3 years at a certain rate of simple interest. If the rate of interest is increased by 4%, what amount will ₹800 become in 3 years?

(a) ₹1020.80 (b) ₹1025
(c) ₹1052 (d) ₹1050

**[SSC (GL), 2011]**

**46.** Simple interest on a certain sum is $\frac{16}{25}$ of the sum. The rate per cent if the rate per cent and time (in years) are equal, is:

(a) 6% (b) 8%
(c) 10% (d) 12%

**[SSC (GL), 2011]**

**47.** Prakash lends a part of ₹20,000 at 8% simple interest and remaining at $\frac{4}{3}$% simple interest. His total income after a year was ₹800. Find the sum lent at 8%.

(a) ₹8,000 (b) ₹12,000
(c) ₹6,000 (d) ₹10,000

**[SSC, 2014]**

**48.** Nitin borrowed some money at the rate of 6% p.a. for the first three years, 9% p.a. for the next five years and 13% p.a. for the period beyond eight years. If the total interest paid by him at the end of eleven years is ₹8,160, the money borrowed by him was:

(a) 12,000 (b) 6,000
(c) 8,000 (d) 10,000

**[SSC Assistant Grade III, 2013]**

**49.** The simple interest on a sum of money is $\frac{1}{9}$th of the principal and the number of years is equal to the rate per cent per annum. The rate per cent per annum is equal to:

(a) 3% (b) $\frac{1}{3}$%
(c) $\frac{1}{10}$% (d) $3\frac{1}{3}$%

**[SSC Assistant Grade III, 2012]**

**50.** Arun lends ₹20,000 to two of his friends. He gives ₹12,000 to the first at 8% p.a. simple interest. Arun wants to makes a profit of 10% on the whole. The simple interest rate at which he should lend the remaining sum of money to the second friend is:

(a) 8% (b) 16%
(c) 12% (d) 13%

**[SSC, 2012]**

**51.** If the simple interest on ₹$x$ at a rate of $a$% for $m$ years is same as that on ₹$y$ at a rate of $a^2$% for $m^2$ years, then $x$:$y$ is equal to:

(a) $m:a$ (b) $am:1$

(c) $\frac{1}{m}:\frac{1}{a}$ (d) $\frac{1}{am}:1$

**[SSC, 2011]**

**52.** A took two loans altogether of ₹1200 from B and C. B claimed 14% simple interest per annum, while C claimed 15% per annum. The total interest paid by A in one year was ₹172. Then a borrowed:

(a) ₹800 from C (b) ₹625 from C
(c) ₹400 from B (d) ₹800 from B

**[SSC, 2011]**

**53.** A person has left an amount of ₹1,20,000 to be divided between his two sons aged 14 years and 12 years such that they get equal amounts when each attains 18 years of age. If the amount gets a simple interest of 5% per annum, the younger son's share at present is:

(a) ₹48,800 (b) ₹57,600
(c) ₹62,400 (d) ₹84,400

**[SSC, 2011]**

**54.** A man invested $\frac{1}{3}$ of his capital at 7%, $\frac{1}{4}$ at 8% and the remaining at 10% rate of simple interest. If his annual income from interests is ₹561, then the capital invested was:

(a)₹6000 (b) ₹5600
(c)₹6600 (d) ₹7200

**[SSC, 2010]**

**55.** A sum of ₹16800 is divided into two parts. One part is lent at a simple rate of interest 6% per annum and the other at 8% per annum. After 2 years the total sum received is ₹19000. The sum lent at the rate of 6% simple interest is:

(a) ₹12200 (b) ₹12000
(c) ₹11000 (d) ₹10000
(e) None of these

**[IBPS PO/MT, 2013]**

**56.** The simple interest accrued on an amount of ₹22,500 at the end of four years is ₹10,800. What would be the compound interest accrued on the same amount at the same rate of interest at the end of two years?

(a) ₹16,908 (b) ₹5,724
(c) ₹28,224 (d) ₹8,586
(e) None of these

**[IBPS PO/MT, 2011]**

**57.** A person rece a simple interest of ₹1,000 on a certain principal at the rate of 5% p.a. in 4 years. What compound interest will would that person receive on twice the principal in two years at the same rate?

(a) ₹1,000 (b) ₹1,005
(c) ₹11,025 (d) ₹10,125
(e) None of these

**[Punjab and Sind Bank PO, 2010]**

**58.** What amount would a man receive on a principal of ₹4,000 after two years on simple interest rate of 5% p.a?

(a) ₹4,161 (b) ₹ 5,200
(c) ₹4,410 (d) ₹4,100
(e) None of these

**[Corporation Bank PO, 2009]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (a) | **3.** (c) | **4.** (a) | **5.** (b) | **6.** (a) | **7.** (a) | **8.** (c) | **9.** (b) | **10.** (c) | **11.** (a) | **12.** (c) | **13.** (b) |
| **14.** (a) | **15.** (b) | **16.** (c) | **17.** (a) | **18.** (c) | **19.** (a) | **20.** (a) | **21.** (a) | **22.** (b) | **23.** (c) | **24.** (a) | **25.** (b) | **26.** (a) |
| **27.** (a) | **28.** (b) | **29.** (c) | **30.** (b) | **31.** (c) | **32.** (a) | **33.** (a) | **34.** (b) | **35.** (a) | **36.** (b) | **37.** (c) | **38.** (a) | **39.** (a) |
| **40.** (b) | **41.** (a) | **42.** (c) | | | | | | | | | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (d) | **2.** (c) | **3.** (a) | **4.** (c) | **5.** (d) | **6.** (b) | **7.** (e) | **8.** (a) | **9.** (c) | **10.** (e) | **11.** (e) | **12.** (a) | **13.** (a) |
| **14.** (c) | **15.** (a) | **16.** (c) | **17.** (a) | **18.** (b) | **19.** (a) | **20.** (a) | **21.** (d) | **22.** (b) | **23.** (d) | **24.** (d) | **25.** (c) | **26.** (c) |
| **27.** (b) | **28.** (b) | **29.** (a) | **30.** (d) | **31.** (c) | **32.** (b) | **33.** (d) | **34.** (c) | **35.** (c) | **36.** (a) | **37.** (d) | **38.** (a) | **39.** (a) |
| **40.** (d) | **41.** (b) | **42.** (a) | **43.** (d) | **44.** (b) | **45.** (c) | **46.** (b) | **47.** (a) | **48.** (c) | **49.** (d) | **50.** (d) | **51.** (b) | **52.** (d) |
| **53.** (b) | **54.** (c) | **55.** (a) | **56.** (b) | **57.** (e) | **58.** (e) | | | | | | | |

## EXPLANATORY ANSWERS

### Exercise-1

**1.** **(b)** Time from May 3rd to July 15th

= 28 days of May + 30 days of June and 15 days of July

= 73 days = $\frac{73}{365}$ years, i.e., $\frac{1}{5}$ years.

$\therefore \quad I = \frac{P \times R \times T}{100} = \frac{500 \times 6 \times \frac{1}{5}}{100}$ = ₹6.

**2.** **(a)** We have, $P$ = ₹10000, $R$ = 8% per annum, $T$ = 6 years.

$\therefore \quad I = \frac{P \times R \times T}{100} = \frac{10000 \times 8 \times 6}{100}$ = ₹4800

$\therefore \quad A = P + I$ = 10000 + 4800 = ₹14800

Thus, Mr Irani returned ₹14800 to the finance company.

**3.** **(c)** Here, $I$ = ₹60, $R$ = 6% per annum, $T$ = 5 years.

$\therefore$ Principal $(P) = \frac{100 \times I}{R \times T} = \frac{100 \times 60}{6 \times 5}$ = ₹200.

**4.** **(a)** Here, $I$ = ₹1770, $R$ = 8% per annum, $T = \frac{15}{2}$ years.

$\therefore$ Principal $(P) = \frac{100 \times I}{R \times T} = \frac{100 \times 1770}{8 \times \frac{15}{2}}$

= ₹2950.

**5.** **(b)** Let the sum of money be ₹$x$.

Then, simple interest = $\frac{3}{8}x$

Also, time = $6\frac{1}{4}$ years, i.e., $\frac{25}{4}$ years

$\therefore$ Rate $(R) = \frac{100 \times I}{P \times T} = \frac{100 \times \frac{3x}{8}}{x \times \frac{25}{4}}$

$= \frac{100 \times 3}{2 \times 25}$ = 6%.

**6.** **(a)** Here, $P$ = ₹5000, $I$ = ₹500, $T$ = 5 years.

Therefore, using the formula

$R = \frac{100 \times I}{P \times T}$

We have, rate of interest $(R) = \frac{100 \times 500}{5000 \times 5}$ = 2% p.a.

**7.** **(a)** We have, $P$ = ₹1200, $T$ = 4 years,

$I$ = 1440 −1200 = ₹240.

$\therefore$ Rate $(R) = \frac{100 \times I}{P \times T} = \frac{100 \times 240}{1200 \times 4}$ = 5% per annum.

**8.** **(c)** Here, $I$ = ₹256.

Let the principal be ₹100.

Let the rate of interest per annum be $x$%.

Then, time ($T$) = $x$ years.

Therefore, using the formula

$$R = \frac{100 \times I}{P \times T}$$

We have, $x = \dfrac{100 \times 256}{100 \times x} \Rightarrow x^2 = 256$ or $x = 16\%$

$\therefore$ Rate of interest per annum is 16%

**9.** **(b)** We have, $T$ = 2 years.

Let the principal be ₹$x$.

Then, simple interest ($I$) = ₹$\dfrac{x}{5}$.

$$\text{Rate of interest } (R) = \frac{100 \times I}{P \times T} = \frac{100 \times \frac{x}{5}}{x \times 2}$$

$$= \frac{100}{5 \times 2} = 10\% \text{ p.a.}$$

**10.** **(c)** Let the principal be ₹$x$, then the simple interest ($I$) $= \dfrac{4}{25}x$.

Let the rate of interest p.a. be $r$%, then time ($T$) = $r$ years.

$$\therefore \quad R = \frac{100 \times I}{P \times T} \Rightarrow r = \frac{100 \times \frac{4}{25}x}{x \times r}$$

$$\Rightarrow r^2 = \frac{400}{25} \text{ or } r = \frac{20}{5} = 4\%.$$

**11.** **(a)** We have, $A$ = ₹1020, $T$ = 4 years, $R$ = 5% p.a.

Let, the principal be ₹$x$.

Then, Interest ($I$) = $A - P$ = 1020 − $x$.

Therefore, by using formula,

$$P = \frac{100 \times I}{R \times T}$$

We have, $x = \dfrac{100 \times (1020 - x)}{5 \times 4}$

$\Rightarrow x = 5100 - 5x$ or, $6x = 5100$

or, $x = \dfrac{5100}{6}$ = ₹850.

$\therefore$ The sum of money borrowed = ₹850.

**12.** **(c)** Here, $P$ = ₹1200, $A$ = ₹1344,

$R$ = 6% p.a.

$\therefore$ Interest (I) = 1344 −1200 = 144

$$\therefore \quad \text{Time } (T) = \frac{100 \times I}{P \times R} = \frac{100 \times 144}{1200 \times 6} = 2 \text{ years.}$$

**13.** **(b)** Income on ₹225 in 4 years at 3%

$$= \frac{P_1 \times R \times T_1}{100} = \frac{225 \times 3 \times 4}{100} ₹27.$$

Now, interest of ₹27 is earned on ₹8100 at 3% simple interest.

$$\therefore \quad \text{Time } (T_2) = \frac{100 \times I}{P_2 \times R} = \frac{100 \times 27}{8100 \times 3} = \frac{1}{9} \text{ year.}$$

**14.** **(a)** The interest earned in 10 years on ₹1000 at 5% per annum

$$= \frac{1000 \times 5 \times 10}{100} = ₹500.$$

The principal now becomes = ₹1000 + ₹500 = ₹1500. We now find the time in which ₹1500 becomes ₹2000 at 5% p.a.

$P$ = ₹1500, $A$ = ₹2000,

$I = A - P$ = 2000 − 1500 = ₹500, $R$ = 5% p.a.

$$\therefore \quad \text{Time } (T) = \frac{100 \times I}{R \times P} = \frac{100 \times 500}{5 \times 1500} = 6\frac{2}{3} \text{ years.}$$

$$\therefore \quad \text{Total time} = \left(10 + 6\frac{2}{3}\right) \text{years} = 16\frac{2}{3} \text{ years.}$$

**15.** **(b)** Interest on ₹500 is = 725 − 500

= ₹225.

$$\text{Time} = \frac{225 \times 100}{500 \times 9} = 5 \text{ years.}$$

$$\therefore \quad \text{Required amount } (A) = P\left(1 + \frac{R \times T}{100}\right)$$

$$= 600 \left(1 + \frac{11 \times 5}{100}\right)$$

= ₹930.

**16.** **(c)** Amount after 1 year $= P\left(1 + \dfrac{R \times T}{100}\right)$

$$= 10000 \left(1 + \frac{20 \times 1}{100}\right)$$

= ₹12000

After paying ₹6000, the remaining sum

= ₹6000

$\therefore$ Amount obtained in the next year

$$= P\left(1 + \frac{R \times T}{100}\right)$$

$$= 6000 \left(1 + \frac{20 \times 1}{100}\right) = ₹7200.$$

**17.** **(a)** We have, $A$ = ₹15000, $R$ = 10% p.a., $T$ = 5 years.

$$\therefore \quad P = \frac{100 \times A}{100 + R \times T} = \frac{100 \times 15000}{100 + 10 \times 5}$$

= ₹10000.

**18.** **(c)** We have, $A$ = ₹47250, $T$ = 3 years, $R$ = 5% p.a.

$$\therefore \quad \text{Annual payment} = \frac{100 \times A}{100 \times T + \frac{RT(T-1)}{2}}$$

$$= \frac{100 \times 47250}{100 \times 3 + \frac{5 \times 3 \times 2}{2}}$$

$= ₹15000.$

**19.** **(a)** Here, $A$ = ₹4200, $T$ = 5 years.

$R$ = 10% p.a.

$\therefore$ Annual instalment $= \dfrac{100 \times A}{100 \times T + \dfrac{RT\,(T-1)}{2}}$

$$= \frac{100 \times 4200}{100 \times 5 + \frac{10 \times 5 \times 4}{2}}$$

$= ₹700.$

**20.** **(a)** Let the sum of money invested by Suresh be ₹$x$. Since the amount obtained in both the cases is equal, the ratio in which the sums are invested is:

$$\frac{1}{100 + R_1T_1} : \frac{1}{100 + R_2T_2}$$

where $R_1$ = 8%, $T_1 = \frac{5}{2}$ years, $R_2$ = 5%, $T_2$ = 2 years.

That is, $\dfrac{1}{100 + 8 \times \frac{5}{2}} : \dfrac{1}{100 + 5 \times 2}$ or, $\dfrac{1}{120} : \dfrac{1}{110}$

Given: $1500 : x :: \dfrac{1}{120} : \dfrac{1}{110}$

$\Rightarrow \dfrac{1500 \times 1}{110} = \dfrac{1}{120} \times x$

or, $x = \dfrac{1500 \times 1 \times 120}{110} = 1636\frac{4}{11}$

$\therefore$ The sum invested by Suresh is ₹$1636\frac{4}{11}$.

**21.** **(a)** We have, $T_1$ = 2 years, $T_2$ = 3 years, $T_3$ = 4 years. $R_1 = R_2 = R_3$ = 5% p.a.

$\therefore$ The ratio in which the amount is invested

$$= \frac{1}{100 + R_1T_1} : \frac{1}{100 + R_2T_2} : \frac{1}{100 + R_3T_3}$$

i.e., $\dfrac{1}{100 + 2 \times 5} : \dfrac{1}{100 + 3 \times 5} : \dfrac{1}{100 + 4 \times 5}$

i.e., $\dfrac{1}{110} : \dfrac{1}{115} : \dfrac{1}{120}$ or, 276:264:253.

Their sum = 276 + 264 + 253 = 793

$\therefore$ The amount invested for

Neeta $= \dfrac{3965}{793} \times 276$ = ₹1380

Sita $= \dfrac{3965}{793} \times 264$ = ₹1320

Gita $= \dfrac{3965}{793} \times 253$ = ₹1265.

**22.** **(b)** We have, $n$ = 4 and $T$ = 24 years.

$\therefore$ Rate of interest $= \dfrac{100(n-1)}{T} = \dfrac{100(4-1)}{24}$

$= 12\frac{1}{2}\%$

**23.** **(c)** Here, $n$ = 3, $R$ = 10% p.a.

$\therefore$ Required time $= \left(\dfrac{n-1}{R}\right) \times 100 = \left(\dfrac{3-1}{10}\right) \times 100$

= 20 years.

**24.** **(a)** We have, $n$ = 2, $T$ = 8 years, $m$ = 3.

$\therefore$ Required Time $(T') = \left(\dfrac{m-1}{n-1}\right) \times T$

$= \left(\dfrac{3-1}{2-1}\right) \times 8$ = 16 years.

**25.** **(b)** Here, change in $SI$ = ₹56, $R_1 - R_2 = 2$, $T$ = 4 years, $P$ = ?

Therefore, using the formula

Change in $SI = \dfrac{PT}{100} \times (R_1 - R_2)$

We get, $56 = \dfrac{P \times 4}{100} \times 2 \Rightarrow P$ = ₹700

$\therefore$ The sum is ₹700.

**26.** **(a)** Here, change in $SI$ = ₹40,

$P_1 - P_2$ = 800 − 400 = ₹400, $T$ = 2 years.

Using, change in $SI = \dfrac{RT}{100} \times (P_1 - P_2)$

We have, $40 = \dfrac{R \times 2}{100} \times 400 \Rightarrow R = 5\%$

**27.** **(a)** Here, change in $SI$ = ₹60,

$R_1 - R_2 = 3 - \dfrac{5}{2} = \dfrac{1}{2}$, $T$ = 4 years, $P$ = ?

Using, change in $SI = \dfrac{PT}{100} \times (R_1 - R_2)$

We have, $60 = \dfrac{P \times 4}{100} \times \dfrac{1}{2} \Rightarrow P$ = ₹3000.

**28.** **(b)** We have, $A_1$ = ₹2800, $A_2$ = ₹3250, $T_1$ = 2 years, $T_2$ = 5 years

$\therefore$ Rate of interest per annum ($R$)

$$= \frac{A_1 - A_2}{A_1T_2 - A_2T_1} \times 100\% = \frac{2800 - 3250}{2800 \times 5 - 3250 \times 2} \times 100\%$$

$$= \frac{450 \times 100}{14000 - 6500}\% = \frac{45000}{7500}\% = 6\%$$

**29.** **(c)** We have, $A_1$ = ₹1760, $A_2$ = 2000, $T_1$ = 2 years, $T_2$ = 5 years.

$\therefore$ Principal $(P) = \dfrac{A_1T_2 - A_2T_1}{T_2 - T_1}$

$= \dfrac{1760 \times 5 - 2000 \times 2}{5 - 2} = \dfrac{4800}{3}$

= ₹1600.

**30.** **(b)** We have, $A_1$ = ₹450, $A_2$ = ₹350, $R_1$ = 7%, $R_2$ = 5%.

$\therefore$ Principal $(P) = \dfrac{A_2R_1 - A_1R_2}{R_1 - R_2}$

$= \dfrac{350 \times 7 - 450 \times 5}{7 - 5} = \dfrac{200}{2}$ = ₹100.

**31.** **(c)** We have, $A_1$ = ₹400, $A_2$ = ₹200, $R_1$ = 10%, $R_2$ = 4%.

$\therefore$ Time $(T) = \dfrac{A_1 - A_2}{A_2R_1 - A_1R_2} \times 100$

$= \dfrac{400 - 200}{200 \times 10 - 400 \times 4} \times 100 = \dfrac{20000}{400}$

= 50 years.

**32.** **(a)** Here, $z$ = ₹9, $a$ = ₹1, $b$ = 12, $n$ = 10, $R$ = ?

Using the formula

$$z = na + \frac{Ra}{100 \times b} \times \frac{n(n-1)}{2},$$

We get, $9 = 10 \times 1 + \dfrac{R \times 1}{100 \times 12} \times \dfrac{10 \times 9}{2}$

$\Rightarrow \dfrac{90R}{2400} = 1 \Rightarrow R = \dfrac{2400}{9} = 266\dfrac{2}{3}\%$

**33.** **(a)** Here, $T_1 = 1$, $T_2 = 2$, $T_3 = 3$,

$$R_1 = R_2 = R_3 = 5\%$$

The shares of Vikas, Vijay and Viraj will be in the ratio

$\dfrac{1}{R_1T_1} : \dfrac{1}{R_2T_2} : \dfrac{1}{R_3T_3} = \dfrac{1}{1 \times 5} : \dfrac{1}{2 \times 5} : \dfrac{1}{3 \times 5}$

$= \dfrac{1}{1} : \dfrac{1}{2} : \dfrac{1}{3} = 6:3:2.$

Sum of proportionals = 6 + 3 + 2 = 11

$\therefore$ Share of Vikas = $\dfrac{6}{11} \times 7700$ = ₹4200

Share of Vijay = $\dfrac{3}{11} \times 7700$ = ₹2100

Share of Viraj = $\dfrac{2}{11} \times 7700$ = ₹1400

Therefore, Vikas's share is 4200 − 1400 = ₹2800 more than that of Viraj.

**34.** **(b)** Let the required sum of money be ₹$x$. Here $R_1$ = 5%, $T_1$ = 4 years, $R_2$ = 4%, $T_2$ = 10 years.

Given: $x:560 = \dfrac{1}{R_1T_1} : \dfrac{1}{R_2T_2} = \dfrac{1}{5 \times 4} : \dfrac{1}{4 \times 10}$

$\Rightarrow \dfrac{x}{560} = \dfrac{2}{1}$ or, $x$ = ₹1120.

**35.** **(a)** Here, $P_1$ = ₹12000, $R_1$ = 10%, $P_2$ = ?, $R_2$ = 20%, $R$ = 14%.

Therefore, using the formula

$$R = \frac{P_1R_1 + P_2R_2}{P_1 + P_2}$$

We get, $14 = \dfrac{12000 \times 10 + P_2 \times 20}{12000 + P_2}$

or, $P_2$ = ₹8000

$\therefore$ Total amount invested = ₹(12000 + 8000)

= ₹20000.

**36.** **(b)** We have, $P_1$ = ₹3000, $R_1$ = 10%, $P_2$ = ₹5000, $R_2$ = 8%.

$\therefore$ Required rate of interest

$= \dfrac{P_1R_1 + P_2R_2}{P_1 + P_2}$

$= \dfrac{3000 \times 10 + 5000 \times 8}{3000 + 5000} = \dfrac{70}{8} = 8\dfrac{3}{4}\%$

**37.** **(c)** We have, $\dfrac{1}{a} = \dfrac{2}{3}, \dfrac{1}{b} = \dfrac{1}{6}$,

$\dfrac{1}{c} = 1 - \left(\dfrac{2}{3} + \dfrac{1}{6}\right) = \dfrac{1}{6}$,

$R_1$ = 3%, $R_2$ = 6%, $R_3$ = 12%, $A$ = ₹25.

$\therefore$ The capital $= \dfrac{A \times 100}{\dfrac{R_1}{a} + \dfrac{R_2}{b} + \dfrac{R_3}{c}}$

$= \dfrac{25 \times 100}{3 \times \dfrac{2}{3} + \dfrac{6}{6} + \dfrac{12}{6}} = \dfrac{2500}{5}$

= ₹500.

**38.** **(a)** Interest for 5 years on the sum = ₹300.

When the principal is trebled, the interest is also trebled.

$\therefore$ Interest for another 5 years on this increased sum = ₹(300 × 3) = ₹900

$\therefore$ Total interest = ₹300 + ₹900 = ₹1200.

**39.** **(a)** The simple interest on ₹1500 invested at a rate of 10% p.a. for 5 years is

$= \dfrac{1500 \times 10 \times 5}{100}$ = ₹750

Now, principal after 5 years = ₹1500 + 750

= ₹2250

Also, final amount = ₹2500

∴ Simple interest = ₹2500 − 2250 = ₹250

∴ Time $(T) = \frac{250 \times 100}{2250 \times 10} = \frac{10}{9}$ years

Hence, total time = 5 + $\frac{10}{9} = \frac{55}{9}$ or $6\frac{1}{9}$ years.

**40.** **(b)** Let the sum of money lent by Sumit to Mohit be ₹$x$.

Then, simple interest paid by Mohit after 1 year

$$= \frac{x \times 5 \times 1}{100} = ₹\frac{5x}{100}$$

Also, the simple interest received by Mohit from Birju after 1 year

$$= \frac{x \times \frac{17}{2} \times 1}{100} = ₹\frac{17x}{200}$$

Given: $\frac{5x}{100} + 350 = \frac{17x}{200}$

$\Rightarrow \frac{5x + 35000}{100} = \frac{17x}{200}$

$\Rightarrow$ $1700x - 1000x = 7000000$

or, $700x = 7000000$

or, $x = \frac{7000000}{700}$ = ₹10000.

Thus, the sum of money lent by Sumit to Mohit is ₹10000.

**41.** **(a)** Simple interest paid by Brinda on ₹1000 for 1 year

$= \frac{1000 \times 5 \times 1}{100}$ = ₹50

Rent received by Brinda from Ramu in 1 year

$= 12\frac{1}{2} \times 12$ = ₹150

∴ Net savings = ₹100

Thus, Brinda will clear the debt of ₹1000 in 10 years.

**42.** **(c)** Let the sum be ₹$x$.

Given: $\frac{x \times 4 \times 2}{100} + \frac{x \times 6 \times 4}{100} + \frac{x \times 8 \times 3}{100} = 1120$

$\Rightarrow$ $56x = 112000$

or, $x = \frac{112000}{56}$ = ₹2000.

## EXERCISE-2
## (BASED ON MEMORY)

**1.** **(d)** 10 + 3% = 103

[Amount after 1st half year @ 3%]

103 + 3% = 106.09

[Amount after 2nd half year @ 3%]

∴ Effective rate of interest = 6.09% per annum

**3.** **(a)** Sum = ₹72, SI = ₹9

Rate % = $6\frac{1}{4} = \frac{25}{4}$

∴ Time = $\frac{9 \times 100}{72 \times \frac{25}{4}} = \frac{9 \times 100}{18 \times 25} = 2$

**4.** **(c)** Let one part be ₹$x$

∴ The other part = ₹$(1500 - x)$

Given: $\frac{x \times 5 \times 10}{100} = \frac{(1500 - x) \times 4}{100} \times \frac{25}{2}$

$\Rightarrow$ $50x = (1500 - x)50$

$\Rightarrow$ $100x = 1500 \times 50$

$\Rightarrow$ $x = 750$

∴ The sum lent out at 12.5% p.a.

= 1500 − $x$ = 750

**5.** **(d)** Principal amount = $\frac{\text{S.I.} \times 100}{\text{T} \times \text{R}}$

$= \frac{8376 \times 100}{8 \times 6}$ = ₹17450

**6.** **(b)** Suppose Manish added ₹$x$ to the borrowed money.

Then

3 × (9 − 6)% of 1150 + (9 × 3)% of $x$ = 274.95

$\Rightarrow$ 9% of 1150 + 27% of $x$ = 274.95

$\Rightarrow$ $x = \frac{274.95 - 103.5}{27} \times 100 =$ ₹635

∴ Required value = 635 + 1150

= ₹1785

**7.** **(e)** (18 × 5)% of 988 = 90% of 988

100% of 988 − 10% of 988

= 988 − 98.8 = ₹889.2

**8. (a)** Let the amount be ₹$x$

According to question,

$$\frac{x \times 14 \times 6}{1200} - \frac{x \times 8 \times 8}{1200} = 250$$

$\therefore$ $x$ = ₹15000.

**9. (c)** Rate of interest $= \frac{956-800}{3 \times 800} \times 100$

$= 6.50\%$

$\therefore$ Amount $= 800 + \frac{800 \times 9.5 \times 3}{100}$

= 800 + 228 = ₹1028.

**10. (e)** Let the amount deposited at the rate of 15% per annum be ₹$x$

15% of $x$ + 18% of $(25000 - x) = 4050$

or, 15% of $x$ + 18% of 25000 − 18% of $x$ = 4050

or, 3% of $x$ = 4500 − 4050

or, $\frac{3}{100} \times x = 450$

or, $x$ = ₹15000

$\therefore$ Amount deposited at 18%

= ₹(25000 − 15000) = ₹10000.

**11. (e)** % interest on total amount per annum

$$= \frac{3620 \times 100}{16500 \times 2} = \frac{362}{33}$$

Now, by Alligation method

| Scheme A | | Scheme B |
|---|---|---|
| 10% | | 12% |
| | $\frac{362}{33}\%$ | |
| $12 - \frac{362}{33}$ | | $\frac{362}{33} - 10$ |

Hence, ratio of amount invested in schemes

A and B $= \left(12 - \frac{362}{33}\right) : \left(\frac{362}{33} - 10\right) = 17:16$

Hence, amount invested in A $= \frac{17 \times 16500}{17+16}$

= ₹8500.

**12. (a)** Let the sum be ₹$P$

Now, 45% of $P$ = 4016.25 or, $P$ = ₹8925.

**13. (a)** Suppose, marked price = ₹100

Price after 1st discount = ₹90

Price after 2nd discount = ₹72

$\therefore$ If S.P. is ₹72, then marked price = ₹100

$\therefore$ If S.P. is ₹540, then marked price

= ₹ $\frac{100}{72} \times 540$ = ₹750.

**14. (c)** Let sum = ₹$P$

Simple interest = ₹$P$

Rate $R = 10\%$

$\therefore$ Time $= \frac{P \times 100}{P \times 10} = 10$ years.

**15. (a)** Suppose present worth = ₹$x$

$\therefore$ $\frac{x \times 5 \times 2}{100} = 132 - x$

$\therefore$ $x = 10(132 - x)$

$\Rightarrow$ $11x = 1320$ or, $x = 120$.

**16. (c)** Suppose ₹$x$ are invested at 6% and ₹$(5000 - x)$ at 9%.

$\therefore$ $\frac{x \times 6 \times 1}{100} + \frac{(5000-x) \times 9 \times 1}{100} = 390 \Rightarrow x = 2000$

$\therefore$ ₹2000 are lent at 6% and ₹3000 at 9%

**17. (a)** Let first part be $x$

Second part be $y$

$\therefore$ Third part $= 2379 - (x + y)$

$\therefore$ $x + \frac{x \times 5 \times 2}{100} = y + \frac{y \times 5 \times 3}{100}$

$= [2379 - (x + y)] + \frac{[2379 - (x+y)] \times 5 \times 4}{100}$ ...(1)

$\therefore$ $x + \frac{x}{10} = y + \frac{3y}{20}$ (from 1)

$\Rightarrow$ $x + \frac{x}{10} = y + \frac{3y}{20}$

$\Rightarrow$ $22x = 23y$ ...(2)

Also $y + \frac{3y}{20} = \frac{6}{5}[2379 - (x + y)]$ (from 1)

$\Rightarrow$ $\frac{23y}{20} = \frac{6}{5}\left[2379 - x - \frac{22x}{23}\right]$ (from 2)

$\Rightarrow$ $\frac{22x}{4} = 6\left[2379 - \frac{45x}{23}\right]$

$\Rightarrow$ $\frac{11x}{12} = 2379 - \frac{45x}{23}$

$\Rightarrow$ $\frac{11x}{12} + \frac{45x}{23} = 2379 \Rightarrow x = 828$.

**18. (b)** Let $P$ be the sum

$\therefore$ $\frac{P \times \frac{5}{2} \times 12}{100} = \frac{P \times \frac{7}{2} \times 10}{100} - 40$

$\Rightarrow$ $\frac{30P}{100} - \frac{35P}{100} = -40 \Rightarrow -\frac{5P}{100} = -40$

$\Rightarrow$ $P = \frac{100 \times 40}{5} = 800$.

**19.** **(a)** Suppose, sum = $K$

$I = 0.125K$

Rate = 10%

$\therefore$ Time = $\dfrac{100 \times 0.125K}{K \times 10} = 1.25 = 1\dfrac{1}{4}$ years.

**20.** **(a)** Let sum = ₹$K$

Time = $T$

$\therefore \quad I = \dfrac{K}{4}$

$\therefore$ Rate % ($R$) = $\dfrac{\frac{K}{4} \times 100}{K \times T} = \dfrac{25}{T}$

$\Rightarrow \quad RT = 25 \Rightarrow R^2 = 25 \qquad (\because R = T)$

$\Rightarrow \quad R = 5.$

**21.** **(d)** Let Principal = ₹$P$

$I$ = ₹$P$

$\therefore \quad T = \dfrac{SI \times 100}{\text{Principal} \times \text{Rate\%}} = \dfrac{P \times 100}{P \times 4}$ = 25 years.

**22.** **(b)** Let sum = ₹$P$

$\therefore \quad \dfrac{P \times 6 \times 10}{100} - \dfrac{P \times 5 \times 2}{100} = 100$

$\Rightarrow$ $60P - 10P = 10000$

$\Rightarrow$ $P = 200.$

**23.** **(d)** Let the sum be ₹$P$

$\therefore \quad \dfrac{P \times 7 \times \frac{9}{2}}{100} - \dfrac{P \times 7 \times 4}{100} = 31.50$

$\Rightarrow \quad \dfrac{63P}{2} - 28P = 3150$

$\Rightarrow$ $7P = 6300 \quad \Rightarrow \quad P = 900.$

**24.** **(d)** Sum = $\dfrac{\text{Difference} \times 100}{|R_1T_1 - R_2T_2|}$

$= \dfrac{42 \times 100}{5}$ = ₹840.

**25.** **(c)** $252 = 1600 \times R \times \dfrac{9}{4} \times \dfrac{1}{100}$ $\qquad \left[I = \dfrac{P \times R \times T}{100}\right]$

$\therefore \quad R = \dfrac{252}{36} = 7\%$

**26.** **(c)** $I = \dfrac{P \times R \times T}{100}$

$80 = \dfrac{400 \times 4 \times R}{100} \quad \Rightarrow \quad R = 5$

If $R = 7$, then

$I = \dfrac{400 \times 4 \times 7}{100} = 112$

$\therefore$ Amount = ₹512.

**27.** **(b)** Let the sum of money be $P$

$I = \dfrac{P \times R \times T}{100} \quad \Rightarrow \quad \dfrac{4}{9}P = \dfrac{P \times R \times T}{100}$

$\therefore \quad R = \sqrt{\dfrac{400}{9}} = \dfrac{20}{3} = 6\dfrac{2}{3}\%\ \%$

**28.** **(b)** Suppose, one part of sum = ₹$x$

$\therefore$ Other part of the sum = ₹$(1500 - x)$

According to question,

$\dfrac{x \times 6 \times 1}{100} + \dfrac{(1500 - x) \times 5 \times 1}{100} = 85$

$6x + 7500 - 5x = 8500$ or, $x = 1000.$

**29.** **(a)** $\dfrac{5000 \times 2\frac{1}{4} \times 2}{100} = 50 \times \dfrac{9}{4} \times 2 = 225$

$\therefore$ Gain per year = ₹112.50.

**31.** **(c)** Required time $= \dfrac{2 \times 100}{5 \times 8}$

= 5 years.

**32.** **(b)** By the method of Alligation

₹440 is 8.8% of 5000

I $\qquad$ II

8% (= 4 × 2) $\qquad$ 10% (= 5 × 2)

8.8%

1.2 (= 10 − 8.8) $\qquad$ 0.8 (= 8.8 − 8)

Hence, required ratio = $\dfrac{1.2}{0.8} = \dfrac{3}{2}$ = 3:2.

**33.** **(d)** Here, $P = 3K$, $I = 2K$, $T = 10$ years

Hence, rate = $\dfrac{2K \times 100}{3K \times 10} = \dfrac{20}{3} = 6\dfrac{2}{3}\%$

**34.** **(c)** Let the sum be ₹$x$

$\therefore \quad \dfrac{x \times 7\frac{1}{2} \times 1\frac{1}{4}}{100} - \dfrac{x \times 12\frac{1}{2} \times \frac{2}{3}}{100} = 32.50$

$\Rightarrow \quad \dfrac{75}{8}x - \dfrac{25}{3}x = 3250$

$\Rightarrow \quad 25x = 3250 \times 24$

$\Rightarrow \quad x = 3120.$

**35.** **(c)** Let the sum be ₹$x$

Let the rate be $R$%

$\therefore \quad \dfrac{x \times 4 \times R}{100} = \dfrac{9}{25}x$

$\Rightarrow \quad R = 9.$

**36.** **(a)** Rate % per annum = $\frac{100[568-520]}{520\times 7-568\times 5}$

$= \frac{100\times 48}{3640-2840}$

$= \frac{100\times 48}{800} = 6\%$

Sum = $\frac{(568-520)\times 100}{(7-5)\times 6} = \frac{48\times 100}{2\times 6}$ = ₹400.

**38.** **(a)** Rate % = $\frac{\left(\frac{41}{40}-1\right)\times 100}{\frac{1}{4}}$ = 10%

**39.** **(a)** His capital = $\frac{55.50}{1.5}$ × 100 = ₹3700.

**40.** **(d)** Let Principal = $P$ and Rate of interest = $R$% per annum.

Then $\frac{P\times R\times 7}{100}$ = 1750

or $PR$ = 25000

Now $I = \frac{P\times(R+2)\times 7}{100} = \frac{25000 \text{x } 7 + P \text{x } 14}{100}$

When we solve this equation, we find that we have two variables and one equation.

Therefore, cannot be determined is the correct answer.

**41.** **(b)** Ratio of Nikhil's investment in difference schemes

= 100: $\frac{150\times 100}{240}$ :150 = 8:5:12

Now, according to the question,

$\frac{8K\times 10}{100}+\frac{5K\times 12}{100}+\frac{12K\times 15}{100}$ = 3200

or, $80K + 60K + 180K = 3200 \times 100$

or, $320K = 3200 \times 100$ or $K = 1000$

∴ Amount invested in scheme $B$ = 1000 × 5

= ₹5000.

**42.** **(a)** 1200 = $\frac{P\times 4\times 8}{100}$

$P = \frac{1200\times 1000}{4\times 8} = 3750$

Now, S.I. = $\frac{3750\times 3\times 6\times 3}{100}$ = 2025.

**43.** **(d)** Let the rate of interest be $x$% per annum.

$\therefore \frac{P\times x\times 4}{100}\times\frac{3}{2} = \frac{P\times x\times 6}{100}$

$6x = 6x$

∴ The value of $x$ cannot be determined.

**44.** **(b)** SI = $2P - P = P$

$\therefore P = \frac{P\times 20\times t}{100}$

$\Rightarrow t = 5$ years.

**45.** **(c)** SI = 956 – 800 = ₹156

Therefore, rate of interest

$= \frac{\text{SI}\times 100}{\text{Principal}\times\text{Time}}$

$= \frac{156\times 100}{800\times 3}$ = 6.5%

per annum.

Thus, new rate = 10.5%

so,

S.I. = $\frac{\text{Principal}\times\text{Time}\times\text{Rate}}{100}$

$= \frac{800\times 3\times 105}{100}$ = ₹252

Hence, Amount = 800 + 252

= ₹1052.

**46.** **(b)** $\frac{\text{Interest}}{\text{Principal}} = \frac{16}{25}$

Therefore, rate of interest

$= \frac{\text{SI}\times 100}{\text{Principal}\times\text{Time}}$

$\Rightarrow x = \frac{16}{25}\times\frac{100}{x}$

$\Rightarrow x^2 = 16 \times 4 = 64$

$\Rightarrow x = \sqrt{64} = 8$ % per annum.

**47.** **(a)** Let the amount lent at 8% rate of interest be ₹$x$.

∴ Amount lent at $\frac{4}{3}$% rate of interest = ₹(20,000 – $x$)

$\therefore \text{SI} = \frac{\text{Principal}\times\text{ Rate}\times\text{ Time}}{100}$

$\therefore \frac{x\times 8\times 1}{100}+\frac{(20000-x)\times\frac{4}{3}\times 1}{100} = 800$

$\Rightarrow \frac{2x}{25}+\frac{20000-x}{75} = 800$

$\Rightarrow \frac{6x+20000-x}{75} = 800$

$\Rightarrow 5x+20000 = 75\times 800 = 60000$

$\Rightarrow 5x = 60000-20,000 = 40000$

$\Rightarrow x = \frac{40000}{5}$ = ₹8000.

**48.** **(c)** Let the sum of money be ₹$x$.

Now, according to the question,

$$\frac{x\times 6\times 3}{100}+\frac{x\times 5\times 9}{100}+\frac{x\times 3\times 13}{100}=8160$$

$$\Rightarrow\quad 18x+45x+39x=816000$$

$$\Rightarrow\quad 120x=816000\quad\Rightarrow\quad x=\frac{816000}{102}=₹8000.$$

**49.** **(d)** If the principal be ₹$P$, then $\text{SI}=\dfrac{P}{9}$

If rate = $r$%, then

$$\text{Rate}=\frac{\text{SI}\times 100}{\text{Principal}\times\text{Time}}$$

$$\Rightarrow\quad r=\frac{1\times 100}{9\times r}=9r^2=100$$

$$\Rightarrow\quad r^2=\frac{100}{9}$$

$$\Rightarrow\quad r=\frac{10}{3}=3\frac{1}{3}\%$$

**50.** **(d)** S1 on ₹12000

$$=\frac{12000\times 8\times 1}{100}=₹960$$

Desired gain on ₹20000

$$=20000\times\frac{10}{100}=₹2000$$

$\therefore$ SI on ₹8000 = (2000 – 960) = ₹1040

$$\therefore\quad \text{Rate}=\frac{\text{SI}\times 100}{\text{Principal}\times\text{Time}}=\frac{1040\times 100}{8000}$$

= 13% per annum.

**51.** **(b)** $\text{SI}=\dfrac{\text{Principal}\times\text{Time}\times\text{Rate}}{100}$

Now, according to the question,

$$\frac{x\times m\times a}{100}=\frac{y\times m^2\times a^2}{100}$$

$$\Rightarrow\quad \frac{x}{y}=\frac{m^2a^2}{ma}=\frac{ma}{1}.$$

**52.** **(d)** Let A borrowed ₹$x$ from B.

$\therefore$ Amount borrowed from $C$ = ₹(1200 – $x$)

Now, according to the question

$$\frac{x\times 14\times 1}{100}+\frac{(1200-x)\times 15\times 1}{100}=172$$

$$\Rightarrow\quad 14x+18000-15x=17200$$

$$\Rightarrow\quad 18000-x=17200$$

$$\Rightarrow\quad x=18000-17200=₹800.$$

**53.** **(b)** Let the younger son's share be ₹$x$.

$\therefore$ Elder son's share = ₹(120000 –$x$)

Now, according to the question,

$$x+\frac{x\times 5\times 6}{100}=(120000-x)+\frac{(120000-x)\times 4\times 5}{100}$$

$$\Rightarrow\quad 20x+6x=20\times 120000-20x+480000-4x$$

$$\Rightarrow\quad 50x=2400000+480000$$

$$\Rightarrow\quad 50x=2880000$$

$$\Rightarrow\quad x=\frac{2880000}{50}=₹57600.$$

**54.** **(c)** Let the total capital invested be ₹$x$

$\therefore$ Total interest

$$=\frac{\frac{1}{3}x\times 7\times 1}{100}+\frac{\frac{1}{4}x\times 8\times 1}{100}+\frac{\left(1-\frac{1}{3}-\frac{1}{4}\right)x\times 10x\times 1}{100}$$

$$=\frac{7x}{300}+\frac{8x}{400}+\frac{5x}{120}$$

$$=\frac{28x+24x+50x}{1200}=\frac{102x}{1200}$$

Now, according to the question,

$$561=\frac{102x}{1200}$$

$$\therefore\quad x=\frac{561\times 1200}{102}=₹6600.$$

**55.** **(a)**

Let the sum lent at 6%rate of interest be ₹$x$.

Then, ₹(1680 – $x$) is lent at 8% rate of interest.

Then, SI = 19000 – 16800 = ₹2200

$$\frac{x\times 6\times 2}{100}+\frac{(16800-x)\times 2\times 8}{100}=2200$$

or,12$x$ + 268800 – 16$x$ = 2200 × 100

or, 268800 – 220000 = 4$x$

$$\text{or,}\quad x=\frac{48800}{4}=₹12200.$$

**56.** **(b)** $r=\dfrac{10800\times 100}{22500\times 4}=12\%$

$$\text{CI}=22500\left(1+\frac{12}{100}\right)^2-22500$$

$$=22500\times\frac{112}{100}\times\frac{112}{100}-22500=28224-22500=5724$$

**57.** **(e)** $\text{Principal (P)}=\dfrac{1000\times 100}{5\times 4}=$ `5000

$$\therefore \text{CI} = 5000 \times 2\left[\left(1+\frac{5}{100}\right)^2 - 1\right]$$

$$= 10000 \times (1.1025 - 1) = ₹1025.$$

***Notes:***

Combined rate of interest for 2 years in case of calculating compound interest

$$\left(5+5+\frac{5\times 5}{100}\right)\% = (10+0.25)\% = 10.25\%$$

Required $\text{CI} = 10000 \times \frac{10.25}{100} = ₹1025$

**58.** **(e)** Required amount $= 4000\left(\frac{100+10}{100}\right) = ₹4400.$

# Compound Interest 18

## INTRODUCTION

In the previous chapter, we discussed simple interest. A second method of paying interest is the *compound interest* method, where the interest for each period is added to the principal before interest is calculated for the next period. With this method, the principal grows as the interest is added to it. This method is used in investments, such as savings account and bonds. An understanding of compound interest is important not only for people planning careers with financial institutions, but also for anyone planning to invest money.

## SOME BASIC FORMULAE

1. (a) The amount $A$ due after $t$ years, when a principal $P$ is given on compound interest at the rate $R\%$ per annum is given by

$$A = P\left(1+\frac{R}{100}\right)^t$$

(b) Compound interest (CI) $= A - P$

$$= P\left[\left(1+\frac{R}{100}\right)^t - 1\right]$$

(c) Rate of interest $(R) = \left[\left(\frac{A}{P}\right)^{1/t} - 1\right]\%$ p.a.

***Note***: Simple interest and compound interest for 1 year at a given rate of interest p.a. are always equal.

**Illustration 1:** Mohan invested an amount of ₹15000 at compound interest rate 5% p.a. for a period of 2 years. What amount will he receive at the end of 2 years?

**Solution:** Here, $P = 15000$, $R = 5$ and $t = 2$.

$$\therefore \quad \text{Amount} = P\left(1+\frac{R}{100}\right)^t$$

$$= 15000\left(1+\frac{5}{100}\right)^2 = 15000\left(1+\frac{1}{20}\right)^2$$

$$= \frac{15000\times 21\times 21}{20\times 20} = ₹16537.50.$$

**Illustration 2:** Find compound interest on ₹5000 for 2 years at 4% p.a.

**Solution:** Here, $P = 5000$, $R = 4$ and $t = 2$.

$$\therefore \quad \text{CI} = P\left[\left(1+\frac{R}{100}\right)^t - 1\right]$$

$$= 5000\left[\left(1+\frac{4}{100}\right)^2 - 1\right]$$

$$= 5000\left[\left(\frac{26}{25}\right)^2 - 1\right] = 5000((1.04)^2 - 1)$$

$$= 5000(1.0816 - 1) = ₹408$$

$\therefore$ The compound interest is ₹408.

**Illustration 3:** Rashi invested ₹16000 for two years at compound interest and received an amount of ₹17640 on maturity. What is the rate of interest?

**Solution:** Here, $P = 16000$, $t = 2$ and $A = 17640$.

$$\therefore \quad R = 100\left[\left(\frac{A}{P}\right)^{1/t} - 1\right]\% \text{ p.a.}$$

$$= 100\left[\left(\frac{17640}{16000}\right)^{1/2} - 1\right]\% \text{ p.a.}$$

$$= 100\left[\left(\frac{441}{400}\right)^{1/2} - 1\right]\% \text{ p.a.}$$

$$= 100\left[\left(\frac{21}{20}\right)^{2\times\frac{1}{2}} - 1\right]\% \text{ p.a.}$$

$$= 100 \times \frac{1}{20} = 5\% \text{ p.a.}$$

2. If the interest is compounded half–yearly, then

   (a) Amount $(A) = P\left(1+\frac{R}{100\times 2}\right)^{2t}$

   (b) Compound interest (CI)

   $$= P\left[\left(1+\frac{R}{100\times 2}\right)^{2t} - 1\right]$$

   (c) Rate $(R) = 2 \times 100\left[\left(\frac{A}{P}\right)^{\frac{1}{t}\times 2} - 1\right]$ % p.a.

**Illustration 4:** Find the amount of ₹8000 in $1\frac{1}{2}$ years at 5% per annum compound interest payable half-yearly.

**Solution:** Here, $P = 8000$, $R = 5$ and $t = \frac{2}{3}$.

$$\therefore \quad \text{Amount} = P\left(1+\frac{R}{100\times 2}\right)^{2t}$$

$$= 8000\left(1+\frac{5}{100\times 2}\right)^{2\times\frac{3}{2}} = 8000\left(\frac{41}{40}\right)^{3}$$

$$= \frac{8000\times 41\times 41\times 41}{40\times 40\times 40} = ₹8615.13.$$

3. If the interest is compounded quarterly, then

   (a) Amount $(A) = P\left(1+\frac{P}{100\times 4}\right)^{4t}$

   (b) Compound interest (CI)

   $$= P\left[\left(1+\frac{R}{100\times 4}\right)^{4t} - 1\right]$$

   (c) Rate $(R) = 4 \times 100\left[\left(\frac{A}{P}\right)^{\frac{1}{t}\times 4} - 1\right]$ % p.a.

4. In general, if the interest is compounded $n$ times a year, then

   (a) Amount $(A) = P\left(1+\frac{R}{100\times n}\right)^{n\times t}$

   (b) Compound interest (CI)

   $$= P\left[\left(1+\frac{R}{100\times n}\right)^{n\times t} - 1\right]$$

   (c) Rate of interest $(R)$

   $$= n \times 100\left[\left(\frac{A}{P}\right)^{\frac{1}{t}\times n} - 1\right] \text{ \% p.a.}$$

**Illustration 5:** Find the compound interest on ₹1000 at 40% per annum compounded quarterly for 1 year.

**Solution:** Here, $P = 1000$, $R = 40$ and $t = 1$.

$\therefore$ Compound interest (CI)

$$= P\left[\left(1+\frac{R}{100\times 4}\right)^{4\times t} - 1\right]$$

$$= 1000\left[\left(1+\frac{40}{100\times 4}\right)^{4\times 1} - 1\right]$$

$$= 1000\left[\left(\frac{11}{10}\right)^{4} - 1\right]$$

$$= 1000\left[\frac{14641-10000}{10000}\right]$$

$= ₹464.10.$

**Illustration 6:** Find the compound interest on ₹4000 at 24% per annum for 3 months, compounded monthly.

**Solution:** Here, $P = 4000$, $R = 24$ and $t = \frac{3}{12}$.

$$\therefore \quad CI = P\left[\left(1+\frac{R}{100\times 12}\right)^{12\times t} - 1\right]$$

$$= 4000\left[\left(1+\frac{24}{100\times 12}\right)^{12\times\frac{3}{12}} - 1\right]$$

$$= 4000\left[\left(\frac{51}{50}\right)^{3} - 1\right] = \frac{4000\times 7651}{50\times 50\times 50}$$

$= ₹244.83.$

## SOME USEFUL SHORT CUT METHODS

1. When the rates of interest are different for different years, say $R_1$, $R_2$, $R_3$ per cent for first, second and third year respectively, then

$$\text{Amount} = P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)\left(1+\frac{R_3}{100}\right).$$

Let the given sum of money be ₹$P$. Amount after first year $= P\left(1+\frac{R_1}{100}\right)$

This amount will be the principal for the second year.

∴ Amount after second year

$$= P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)$$

This amount will be the principal for the third year.

∴ Amount after third year

$$= P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)\left(1+\frac{R_3}{100}\right).$$

**Illustration 7:** Anu invests ₹5000 in a bond which gives interest at 4% per annum during the first year, 5% during the second year and 10% during the third year. How much does she get at the end of the third year.

**Solution:** Here, $P = 5000$, $R_1 = 4$, $R_2 = 5$ and $R_3 = 10$.

∴ Amount at the end of third year

$$= P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)\left(1+\frac{R_3}{100}\right)$$

$$= 5000\left(1+\frac{4}{100}\right)\left(1+\frac{5}{100}\right)\left(1+\frac{10}{100}\right)$$

$$= 5000 \times \frac{26}{25}\times\frac{21}{20}\times\frac{11}{10} = ₹6006.$$

2. When the time is given in the form of fraction, say $3\frac{3}{4}$ years, then

$$\text{Amount} = P\left(1+\frac{R}{100}\right)^3 \times \left(1+\frac{\frac{3}{4}R}{100}\right).$$

**Illustration 8:** What will be the compound interest on ₹15625 for $2\frac{1}{2}$ years at 4% per annum?

**Solution:** $\text{CI} = 15625\left[\left(1+\frac{4}{100}\right)^2\left(1+\frac{4\times\frac{1}{2}}{100}\right)-1\right]$

$$= 15625\left[\frac{26}{25}\times\frac{26}{25}\times\frac{51}{50}-1\right]$$

$$= \frac{15625\times 3226}{31250} = ₹1613.$$

3. (a) The difference between the compound interest and the simple interest on a certain sum of money for 2 years at $R$% per annum is given by

$$\text{CI} - \text{SI} = P\left(\frac{R}{100}\right)^2 \quad \text{[in terms of } P \text{ and } R]$$

$$\text{and, CI} - \text{SI} = \frac{R\times \text{SI}}{2\times 100} \quad \text{[in terms of SI and } R]$$

Let, ₹$P$ be given sum of money. Simple interest on ₹$P$ for 2 years at $R$% per annum

$$= \frac{P\times R\times 2}{100}$$

and compound interest on ₹$P$ for 2 years at $R$% per annum

$$= P\left[\left(1+\frac{R}{100}\right)^2-1\right]$$

$$\therefore \quad \text{CI} - \text{SI} = P\left[\left(1+\frac{R}{100}\right)^2-1\right] - \frac{P\times R\times 2}{100}$$

$$= P\left[1+\frac{R^2}{10000}+\frac{2R}{100}-1-\frac{2R}{100}\right]$$

$$= P\left(\frac{R}{100}\right)^2$$

$$\text{Also, } CI - SI = P\left(\frac{R}{100}\right)^2 = \frac{R}{100\times 2}\times\left(\frac{P\times R\times 2}{100}\right)$$

$$= \frac{R\times SI}{2\times 100}.$$

(b) The difference between the compound interest and the simple interest on a certain sum of money for 2 years at $R$% per annum is given by

$$\text{CI} - \text{SI} = P\left[\left(\frac{R}{100}\right)^3 + 3\left(\frac{R}{100}\right)^2\right]$$

[in terms of $P$ and $R$]

$$\text{and, CI} - \text{SI} = \frac{SI}{3}\left[\left(\frac{R}{100}\right)^2 + 3\left(\frac{R}{100}\right)\right]$$

[in terms of SI and $R$]

Let, ₹$P$ be the given sum of money. Simple interest on ₹$P$ for 3 years at $R$% per annum

$$= \frac{P \times R \times 3}{100}$$

and compound interest on ₹$P$ for 3 years at $R$% per annum

$$= P\left[\left(1 + \frac{R}{100}\right)^3 - 1\right]$$

$$\therefore \text{ CI} - \text{SI} = P\left[\left(1 + \frac{R}{100}\right)^3 - 1\right] - \frac{P \times R \times 3}{100}$$

$$= P\left[1 + \frac{R^3}{100000} + \frac{3R^2}{10000} + \frac{3R}{100} - 1 - \frac{3R}{100}\right]$$

$$= P\left[\frac{R^3}{1000000} + \frac{3R^2}{1000}\right]$$

$$= P\left[\left(\frac{R}{100}\right)^3 + 3\left(\frac{R}{100}\right)^2\right]$$

$$= \frac{P \times R \times 3}{100} \times \frac{1}{3}\left[\left(\frac{R}{100}\right)^2 + 3\left(\frac{R}{100}\right)\right]$$

$$= \frac{SI}{3}\left[\left(\frac{R}{100}\right)^2 + 3\left(\frac{R}{100}\right)\right].$$

**Illustration 9:** What will be the difference between simple and compound interest on a sum of ₹4500 put for 2 years at 5% per annum?

**Solution:** Here, $P = 4500$ and $R = 5$.

$$\therefore \quad \text{CI} - \text{SI} = P\left(\frac{R}{100}\right)^2 = 4500\left(\frac{5}{100}\right)^2$$

$$= \frac{4500}{20 \times 20} = ₹11{\cdot}25.$$

**Illustration 10:** If the difference between the compound interest and simple interest on a certain sum of money for 3 years at 5% per annum is ₹61, find the sum.

**Solution:** Here, CI − SI = 61 and $R = 5$.

$$\therefore \quad \text{CI} - \text{SI} = P\left[\left(\frac{R}{100}\right)^3 + 3\left(\frac{R}{100}\right)^2\right]$$

$$\Rightarrow \quad 61 = P\left[\left(\frac{5}{100}\right)^3 + 3\left(\frac{5}{100}\right)^2\right]$$

$$= P\left[\left(\frac{1}{20}\right)^3 + 3\left(\frac{1}{20}\right)^2\right]$$

$$= P\left[\frac{1 + 3 \times 20}{20 \times 20 \times 20}\right] = P\left(\frac{61}{20 \times 20 \times 20}\right)$$

$$\Rightarrow \quad P = ₹8000.$$

4. If a certain sum becomes $n$ times in $t$ years at compound interest, then the same sum becomes $n^m$ times in $mt$ years.

Let, ₹$P$ be the given sum of money. We have,

$$nP = P\left(1 + \frac{R}{100}\right)^t \Rightarrow n = \left(1 + \frac{R}{100}\right)^t \quad \cdots(1)$$

Let the sum become $n^m$ times in $T$ years.

$$\text{Then, } n^m = \left(1 + \frac{R}{100}\right)^T$$

$$\text{or,} \quad n = \left(1 + \frac{R}{100}\right)^{T/m} \quad \cdots(2)$$

On comparing equations (1) and (2), we get $T/m = t$ or $T = mt$ years.

Therefore, the sum becomes $n^m$ times in $mt$ years.

**Illustration 11:** A sum of money placed at compound interest doubles in 3 years. In how many years will it become four times?

**Solution:** Here, $n = 2$, $t = 3$ and $m = 2$

∴ The given sum of money will become four times itself in $mt$, i.e., $2 \times 3 = 6$ years.

5. If a certain sum becomes $n$ times in $t$ years, then the rate of compound interest is given by

$$R = 100[(n)^{1/t} - 1].$$

**Illustration 12:** At what rate per cent compound interest does a sum of money become four–fold in 2 years?

**Solution:** The required rate per cent is

$$R = 100[(n)^{1/t} - 1] = 100[(4)^{1/2} - 1]$$
$$= 100(2 - 1) = 100\%$$

[Here, $n = 4$ and $t = 2$]

> 6. If a certain sum of money at compound interest amounts to ₹$x$ in $A$ years and to ₹$y$ in $B$ years, then the rate of interest per annum is
>
> $$R = \left[\left(\frac{y}{x}\right)^{1/B-A} - 1\right] \times 100\%.$$

Let the principal be ₹$P$ and the rate of interest be $R$% p.a.

Given: $x = P\left(1+\frac{R}{100}\right)^A$ and $y = P\left(1+\frac{R}{100}\right)^B$

$$\therefore \quad \frac{y}{x} = \frac{\left(1+\frac{R}{100}\right)^B}{\left(1+\frac{R}{100}\right)^A} = \left(1+\frac{R}{100}\right)^{B-A}$$

$$\therefore \quad \left(\frac{y}{x}\right)^{1/B-A} = 1 + \frac{R}{100} \quad \text{or} \quad \frac{R}{100} = \left(\frac{y}{x}\right)^{1/B-A} - 1$$

$$\text{or,} \quad R = \left[\left(\frac{y}{x}\right)^{1/B-A} - 1\right] \times 100.$$

**Illustration 13:** A sum of money at compound interest amounts to ₹4050 in one year and to ₹4723.92 in 3 years. Find the rate of interest per annum.

**Solution:** Here, $x = 4050$, $y = 4723.92$, $A = 1$ and $B = 3$.

$$\therefore \quad R = \left[\left(\frac{y}{x}\right)^{1/B-A} - 1\right] \times 100\%$$

$$= \left[\left(\frac{4723\cdot 92}{4050}\right)^{1/2} - 1\right] \times 100\%$$

$$= \left(\frac{27}{25} - 1\right) \times 100\% = 8\%$$

> 7. If a loan of ₹$P$ at $R$% compound interest per annum is to be repaid in $n$ equal yearly instalments, then the value of each instalment is given by
>
> $$₹\frac{P}{\left(\frac{100}{100+R}\right) + \left(\frac{100}{100+R}\right)^2 + \cdots \left(\frac{100}{100+R}\right)^n}.$$

Let each instalment be of ₹$X$.

$\therefore$ Principal for the amount of ₹$X$ due at end of first year at $R$%

$$= \frac{100X}{100+R}$$

Principal for the amount of ₹$X$ due at the end of second year at $R$%

$$= \left(\frac{100}{100+R}\right)^2 X$$

$\vdots \qquad \vdots \qquad \vdots$

Principal for the amount of ₹$X$ due at the end of nth year at $R$%

$$= \left(\frac{100}{100+R}\right)^n X$$

$$\therefore \quad \frac{100X}{100+R} + \left(\frac{100}{100+R}\right)^2 X + \ldots \left(\frac{100}{100+R}\right)^n X = P$$

$$\text{or,} \quad X = ₹\frac{P}{\left(\frac{100}{100+R}\right) + \left(\frac{100}{100+R}\right)^2 + \cdots \left(\frac{100}{100+R}\right)^n}.$$

**Illustration 14:** If a sum of ₹13040 is to be paid back in two equal annual instalments at $3\frac{3}{4}$% per annum, what is the amount of each instalment?

**Solution:** Each instalment $= \dfrac{P}{\left(\frac{100}{100+R}\right) + \left(\frac{100}{100+R}\right)^2}$

$$= \frac{13040}{\left(\frac{100}{100+\frac{15}{4}}\right) + \left(\frac{100}{100+\frac{15}{4}}\right)^2}$$

$$\left[\text{Here, } P = 13040 \text{ and } R = \frac{15}{4}\right]$$

$$= \frac{13040}{\frac{400}{415} + \left(\frac{400}{415}\right)^2} = \frac{13040}{\frac{400}{415}\left(1 + \frac{400}{415}\right)}$$

$$= 13040 \times \frac{415}{400} \times \frac{815}{400}$$

$$= ₹6889.$$

## EXERCISE-1

1. Nikita invested ₹8000 for 3 years at 5% CI in a post office. If the interest is compounded once in a year, what sum will she get after 3 years?
   (a) ₹9261 (b) ₹8265
   (c) ₹9365 (d) None of these

2. The compound interest on ₹2000 at 5% per annum, compounded yearly, for 2 years is:
   (a) ₹315 (b) ₹425
   (c) ₹205 (d) None of these

3. At what rate per cent per annum will ₹1000 amount to ₹1331 in 3 years? The interest is compounded yearly.
   (a) 10% p.a. (b) 12% p.a.
   (c) 13% p.a. (d) None of these

4. Find the present worth of ₹9261 due 3 years, hence at 5% per annum compounded yearly.
   (a) ₹7000 (b) ₹8000
   (c) ₹9000 (d) None of these

5. The compound interest on ₹10000 at 20% per annum at the end of 1 year 6 months if the interest is calculated half-yearly will be:
   (a) ₹5320 (b) ₹3310
   (c) ₹4340 (d) None of these

6. A sum put out at 4% compound interest payable half-yearly amounts to ₹6632.55 in $1\frac{1}{2}$ years. The sum is:
   (a) ₹6530 (b) ₹6250
   (c) ₹6470 (d) None of these

7. The compound interest on ₹12000 for 9 months at 20% per annum, interest being compounded quarterly, is:
   (a) ₹1891.50 (b) ₹1901.50
   (c) ₹1791.50 (d) None of these

8. The difference of compound interest on ₹800 for 1 year at 20% per annum when compounded half-yearly and quarterly is:
   (a) ₹4.40 (b) Nil
   (c) ₹6.40 (d) None of these

9. The difference between the simple interest and the compound interest on ₹60 for 1 year at 10% per annum, reckoned half-yearly is:
   (a) ₹1 (b) ₹$1\frac{1}{2}$
   (c) ₹2 (d) None of these

10. ₹800 at 5% per annum compound interest amount to ₹882 in:
    (a) 6 years (b) 2 years
    (c) 4 years (d) None of these

11. What will be the compound interest on a sum of ₹1875 after 2 years if the rate of interest for the first year is 4% and that for the second year is 8%?
    (a) ₹231 (b) ₹341
    (c) ₹241 (d) None of these

12. What will be the amount if a sum of ₹5000 is placed at compound interest for 3 years while rate of interest for the first, second and third years is 2, 3 and 4 per cent, respectively?
    (a) ₹5643.12 (b) ₹5463.12
    (c) ₹6413.12 (d) None of these

13. What sum will amount to ₹15916.59 in 3 years at compound interest, the interest for first, second and third year being 3, 2 and 1 per cent, respectively?
    (a) ₹18000 (b) ₹12000
    (c) ₹15000 (d) None of these

14. The compound interest on ₹800 in $2\frac{1}{2}$ years at 5% is:
    (a) ₹105.05 (b) ₹104.05
    (c) ₹106.05 (d) None of these

15. On what sum will the compound interest for $2\frac{1}{2}$ years at 10% amount to ₹6352.50?
    (a) ₹7000 (b) ₹8000
    (c) ₹5000 (d) None of these

16. The compound interest on a sum of money for 3 years at 5% is ₹1324.05. What is the simple interest?
    (a) ₹1460 (b) ₹1365
    (c) ₹1260 (d) None of these

17. The simple interest on a certain sum at 4% per annum for 2 years is ₹80. The compound interest on the same sum for the same period is:
    (a) ₹91.60 (b) ₹81.60
    (c) ₹71.60 (d) None of these

18. If the compound interest on a certain sum for 2 years is ₹60·60 and the simple interest is ₹60, then the rate of interest per annum is:

(a) 2% (b) 3%
(c) 4% (d) None of these

**19.** If the compound interest on a certain sum for 2 years is ₹105 and simple interest is ₹100, then the sum is:

(a) ₹300 (b) ₹500
(c) ₹400 (d) None of these

**20.** The difference between simple interest and compound interest on ₹1250 for 2 years at 4% p.a. is:

(a) ₹3 (b) ₹4
(c) ₹2 (d) None of these

**21.** On a certain sum of money, the simple interest for 2 years is ₹200 at the rate of 7% per annum. Find the difference in *CI* and *SI*.

(a) ₹7 (b) ₹9
(c) ₹11 (d) None of these

**22.** The difference between the compound interest and simple interest on a certain sum at 5% for 2 years is ₹1.50. The sum is:

(a) ₹700 (b) ₹600
(c) ₹500 (d) None of these

**23.** The difference between the compound interest and simple interest on a certain sum at 3% per annum for 3 years is ₹27.27. The sum is:

(a) ₹12000
(b) ₹15000
(c) ₹10000
(d) None of these

**24.** The difference between the compound interest and the simple interest on ₹8000 for 3 years at 5% per annum is:

(a) ₹61 (b) ₹63
(c) ₹65 (d) None of these

**25.** If a sum of money at compound interest amounts to thrice itself in 3 years, then in how many years will it be 9 times itself?

(a) 9 years
(b) 6 years
(c) 7 years
(d) None of these

**26.** At what rate per cent compound interest does a sum of money become 16 times in 4 years?

(a) 75% (b) 100%
(c) 50% (d) None of these

**27.** A certain sum of money at compound interest grows up to ₹12960 in 2 years and up to ₹13176 in 3 years. Find the rate per cent per annum.

(a) $1\frac{1}{3}\%$ (b) $2\frac{1}{3}$

(c) $1\frac{2}{3}\%$ (d) None of these

**28.** What sum of money at compound interest will amount to ₹650 at the end of the first year and ₹676 at the end of the second year?

(a) ₹825 (b) ₹925
(c) ₹625 (d) None of these

**29.** A sum of ₹1260 is borrowed from a money lender at 10% p.a. compounded annually. If the amount is to be paid back in two equal annual instalments, find out the annual instalment.

(a) ₹726 (b) ₹626
(c) ₹526 (d) None of these

**30.** A tree increases annually by $\frac{1}{8}$ of its height. By how much will it increase after 2 years, if it stands today 64 cm high?

(a) 72 cm (b) 74 cm
(c) 75 cm (d) 81 cm

**31.** The least number of completed years in which a sum of money put out at 20% CI will be more than doubled is:

(a) 3 (b) 4
(c) 5 (d) 6

**32.** A man borrows ₹4000 from a bank at $7\frac{1}{2}\%$ compound interest. At the end of every year he pays ₹1500 as part repayment of loan and interest. How much does he still owe to the bank after three such instalments?

(a) ₹123.25 (b) ₹125
(c) ₹400 (d) ₹469.18

**33.** If in a certain number of years, ₹3000 amounts to ₹4320 at a compound interest, in half that time ₹3000 will amount to:

(a) ₹3400 (b) ₹3600
(c) ₹3800 (d) ₹3520

**34.** ₹3757 is to be divided between A and B such that A's share at the end of 7 years may be equal to B's share at the end of 9 years. If rate per cent be 10% p.a. compound interest, B's share is:

(a) ₹1700 (b) ₹1500
(c) ₹2057 (d) ₹1400

## Exercise-2
## (Based on Memory)

**1.** A sum of money becomes ₹4500 after two years and ₹6750 after 4 years on compound interest. The sum is:

(a) ₹4000 (b) ₹2500
(c) ₹3000 (d) ₹3050

**[SSC (GL) Prel. Examination, 2005]**

**2.** At what rate per cent per annum will ₹2304 amount to ₹2500 in 2 years at compound interest?

(a) $4\frac{1}{2}\%$ (b) $4\frac{1}{5}\%$
(c) $4\frac{1}{6}\%$ (d) $4\frac{1}{3}\%$

**[SSC (GL) Prel. Examination, 2005]**

**3.** The difference between simple interest and compound interest on a certain sum of money for 2 years at 4 per cent per annum is ₹1. The sum of money is:

(a) ₹600 (b) ₹625
(c) ₹560 (d) ₹650

**[SSC (GL) Prel. Examination, 2005]**

**4.** A sum of money invested at compound interest doubles itself in 6 years. At the same rate of interest, it will amount to eight times of itself in:

(a) 15 years (b) 12 years
(c) 18 years (d) 10 years

**[SSC (GL) Prel. Examination, 2005]**

**5.** Mr 'X' invested certain amounts in two different schemes 'A' and 'B'. Scheme 'A' offers simple interest @ 12 percent p.a. and scheme 'B' offers compound interest @ 10 per cent p.a. Interest accrued on the amount invested in scheme 'A' in 2 years was ₹3600 and the total amount invested was ₹35000. What was interest accrued on the amount invested in scheme 'B'?

(a) ₹4800 (b) ₹4200
(c) ₹4000 (d) Cannot be determined
(e) None of these

**[SBI PO, 2005]**

**6.** The difference between the simple interest and compound interest obtained on a principal amount at 5 per cent p.a. after 2 years is ₹35. What is the principal amount?

(a) ₹15000 (b) ₹10000
(c) ₹14000 (d) ₹13000

**[Bank of Maharashtra, SO 2006]**

**7.** What would be the compound interest accrued on an amount of ₹15000 at the rate of 15 per cent p.a. at the end of three years?

(a) ₹7813.125 (b) ₹7762.50
(c) ₹7762.125 (d) ₹11235.09375
(e) None of these

**[IOB PO, 2006]**

**8.** Sriram invested equal sums of money in two schemes. Under scheme X, the compound interest rate was 10 per cent p.a. and under scheme Y, the compound interest rate was 12 per cent p.a. The interest after two years on the sum invested in scheme X was ₹63. How much is the interest earned under scheme Y after two years?

(a) ₹79.0272 (b) ₹70.56
(c) ₹76.32 (d) Cannot be determined
(e) None of these

**[IOB PO, 2006]**

**9.** The simple interest accrued on an amount of ₹15500 at the end of three years is ₹5580. What would be the compound interest accrued on the same amount at the same rate in the same period?

(a) ₹6726.348 (b) ₹6276.384
(c) ₹6267.834 (d) ₹6627.438
(e) None of these

**[Corporation Bank PO, 2007]**

**10.** What approximate compound interest can be obtained on an amout of ₹3980 after 2 years at 8 per cent p.a.?

(a) ₹650 (b) ₹680
(c) ₹600 (d) ₹5905
(e) ₹665

**[Allahabad Bank SO, 2007]**

**11.** What will be the difference in simple and compound interest @ 12% per annum on a sum of ₹960 after 2 years?

(a) ₹13.824 (b) ₹24.04
(c) ₹20.224 (d) ₹31
(e) None of these

**[Andhra Bank PO, 2007]**

**12.** The simple interest accrued on an amount of ₹14800 at the end of three years is ₹6216. What would be the compound interest accrued on the same amount at the same rate in the same period?

(a) ₹6986.1142 (b) ₹7042.2014
(c) ₹7126.8512 (d) ₹8321.4166
(e) None of these

**[Corporation Bank PO, 2006]**

**13.** What approximate amount of compound interest can be obtained on an amount of ₹4890 at the rate of 5 per cent p.a. at the end of two years?

(a) ₹4522 (b) ₹4893
(c) ₹515 (d) ₹5205
(e) ₹501

**[LIC ADO, 2007]**

**14.** Mr Rao invests a sum of ₹41250 at the rate of 6 per cent p.a. What approximate amount of compound interest will he obtain at the end of 3 years?

(a) ₹8100 (b) ₹7425
(c) ₹8210 (d) ₹7879
(e) ₹7295

**[SBI PO, 2008]**

**15.** What will be the difference between the simple interest and compound interest earned on a sum of ₹985 @ 14 per cent p.a. at the end of two years?

(a) ₹16.408 (b) ₹14.214
(c) ₹19.218 (d) ₹17.405
(e) ₹19.306

**[Bank of Maharashtra PO, 2007]**

**16.** If the difference between the simple interest and compound interest earned on an amount @ 15 per cent p.a. at the end of 3 years is ₹595.35, what is the amount?

(a) ₹8400 (b) ₹9200
(c) ₹6800 (d) Cannot be determined
(e) None of these

**[Allahabad Bank PO, 2007]**

**17.** A builder borrows ₹2550 to be paid back with compound interest at the rate of 4% per annum by the end of 2 years in two equal yearly instalments. How much will each instalment be?

(a) ₹1352 (b) ₹1377
(c) ₹1275 (d) ₹1283

**[SSC (GL) Prel. Examination, 2000]**

**18.** At what per cent per annum will ₹3000 amount to ₹3993 in 3 years if the interest is compounded annually?

(a) 9% (b) 10%
(c) 11% (d) 13%

**[SSC (GL) Prel. Examination, 2000]**

**19.** What annual payment will discharge a debt of ₹1025 due in 2 years at the rate of 5% compound interest?

(a) ₹551.25 (b) ₹550.00
(c) ₹560.00 (d) ₹560.75

**[SSC (GL) Prel. Examination, 2000]**

**20.** The compound interest on ₹10000 in 2 years at 4% per annum, the interest being compounded half-yearly, is:

(a) ₹636.80 (b) ₹824.32
(c) ₹912.86 (d) ₹828.82

**[SSC (GL) Prel. Examination, 2000]**

**21.** If the difference between the compound interest compounded every six months and the simple interest on a certain sum of money at the rate of 12% per annum for one year is ₹36, the sum is:

(a) ₹10000 (b) ₹12000
(c) ₹15000 (d) ₹9000

**[SSC (GL) Prel. Examination, 2000]**

**22.** In how many years will ₹2000 amount to ₹2420 at 10% per annum compound interest?

(a) 3 (b) $2\frac{1}{2}$
(c) 2 (d) $1\frac{1}{2}$

**[SSC (GL) Prel. Examination, 2000]**

**23.** What is the difference between compound interest on ₹5000 for $1\frac{1}{2}$ years at 40% per annum according as the interest is compounded yearly or half yearly?

(a) ₹2.04 (b) ₹3.06
(c) ₹8.30 (d) ₹4.80
(e) None of these

**[SSC (GL) Prel. Examination, 2000]**

**24.** The principal that amounts to `4913 in 3 years at $6\frac{1}{4}$% per annum compound interest compounded annually is:

(a) ₹4096 (b) ₹4085
(c) ₹4076 (d) ₹3096

**[SSC (GL) Prel. Examination, 2000]**

**25.** What sum lent at 5% per annum compound interest will amount to ₹441 in 2 years?

(a) ₹390 (b) ₹395
(c) ₹400 (d) ₹405

**[SSC (GL) Prel. Examination, 2000]**

**26.** The compound interest on a certain sum for two years is ₹618 whereas the simple interest on the same sum at the same rate for two years is ₹600. The rate of interest per annum is:

(a) 18% (b) 9%
(c) 6% (d) 3%

**[SSC (GL) Prel. Examination, 2000]**

**27.** The effective annual rate of interest corresponding to a nominal rate of 6% per annum payable half-yearly is:

(a) 6.06% (b) 6.07%
(c) 6.08% (d) 6.09%

**[SSC (GL) Prel. Examination, 2000]**

**28.** The difference between the simple and compound interest on a certain sum of money for 2 years at 4% per annum is ₹1. The sum is:

(a) ₹676 (b) ₹675
(c) ₹625 (d) ₹700

**[SSC (GL) Prel. Examination, 2002]**

**29.** A sum of money doubles itself in 4 years at compound interest. It will amount to 8 times itself at the same rate of interest in:

(a) 18 years (b) 12 years
(c) 16 years (d) 24 years

**[SSC (GL) Prel. Examination, 2002]**

**30.** The difference between the simple and compound interest on a certain sum of money at 5% rate of interest per annum for 2 years is ₹15. The sum is:

(a) ₹6500 (b) ₹5500
(c) ₹6000 (d) ₹7000

**[SSC (GL) Prel. Examination, 2002]**

**31.** A sum borrowed under compound interest doubles itself in 10 years. When will it become fourfold of itself at the same rate of interest?

(a) 15 years (b) 20 years
(c) 24 years (d) 40 years

**[SSC (GL) Prel. Examination, 2002]**

**32.** A sum of money invested at compound interest amounts in 3 years to ₹2400 and in 4 years to ₹2520. The interest rate per annum is:

(a) 5% (b) 6%
(c) 10% (d) 12%

**[SSC (GL) Prel. Examination, 2002]**

**33.** A sum of money placed at compound interest doubles itself in 5 years. It will amount to eight times itself at the same rate of interest in:

(a) 10 years (b) 15 years
(c) 7 years (d) 20 years

**[SSC (GL) Prel. Examination, 2002]**

**34.** A sum of money invested at compound interest amounts to ₹800 in 3 years and to ₹840 in 4 years. The rate of interest per annum is:

(a) $2\frac{1}{2}\%$ (b) 4%
(c) 5% (d) $6\frac{2}{3}\%$

**[SSC (GL) Prel. Examination, 2002]**

**35.** In what time will ₹1000 amount to ₹1331 at 20% per annum, compounded half-yearly?

(a) $1\frac{1}{2}$ years (b) 2 years
(c) 1 year (d) $2\frac{2}{3}$ years

**[SSC (GL) Prel. Examination, 2003]**

**36.** The difference between simple and compound interest (compounded annually) on a sum of money for 2 years at 10% per annum is ₹65. The sum is:

(a) ₹6505 (b) ₹6566
(c) ₹6565 (d) ₹6500

**[SSC (GL) Prel. Examination, 2003]**

**37.** A man gets a simple interest of ₹1000 on a certain principal at the rate of 5% per annum in 4 years. What compound interest will the man get on twice the principal in two years at the same rate?

(a) ₹1050 (b) ₹1005
(c) ₹11025 (d) None of these

**[Punjab and Sind Bank PO, 2010]**

**38.** Sonika invested an amount of ₹5800 for 2 years. At what rate of compound interest will she get an amount of ₹594.5 at the end of two years?

(a) 5% per annum
(b) 4% per annum
(c) 6% per annum
(d) 8% per annum

**[Corporation Bank PO, 2010]**

**39.** The simple interest accrued on an amount of ₹27500 at the end of three years is ₹10230. What would be the approximate compound interest accrued on the same amount at the same rate in the same period?

(a) ₹11550 (b) ₹12620
(c) ₹10950 (d) ₹11900

**[New Indian Insurance PO, 2009]**

**40.** Mr Duggal invested ₹20000 with rate of interest @ 20% per annum. The interest was compounded half-yearly for first one year and in the next year it was compounded yearly. What will be the total interest earned at the end of two years?

(a) ₹8800 (b) ₹9040
(c) ₹8040 (d) ₹9800

**[United Bank of India PO, 2009]**

**41.** In how many years will a sum of ₹800 at 10% per annum compound interest, compounded semi-annually becomes ₹926.10?

(a) $1\frac{1}{2}$ (b) $1\frac{2}{2}$
(c) $2\frac{1}{3}$ (d) $2\frac{1}{2}$

**[SSC (GL), 2010]**

**42.** Kruti took a loan at simple interest rate of 6% in the first year with an increase of 0.5% in each subsequent year. She paid interest of ₹3375 after four years. How much loan did she take?

(a) ₹12500 (b) ₹33250
(c) ₹15800 (d) Cannot be determined

**[Dena Bank PO, 2008]**

**43.** A sum of money placed at compound interest doubles itself in 4 years. In how many years will it amount to four times itself?

(a) 12 years (b) 13 years
(c) 8 years (d) 16 years

**[SSC (GL), 2011]**

**44.** A sum of ₹12,000 deposited at compound interest becomes double after 5 years. After 20 years, it will become:

(a) ₹48,000 (b) ₹96,000
(c) ₹1,90,000 (d) ₹1,92,000

**[SSC (GL), 2011]**

**45.** If the difference between S.I. and CI for 2 years on a sum of money lent at 5% is ₹6, then the sum is:

(a) ₹2200 (b) ₹2400
(c) ₹2600 (d) ₹2000

**[SSC (GL), 2011]**

**46.** A sum of money at compound interest doubles itself in 15 years. It will become eight times of itself in:

(a) 45 years (b) 48 years
(c) 54 years (d) 60 years

**[SSC (GL), 2010]**

**47.** A person takes ₹10,000 loan at the rate of 10% interest compounding yearly for the period of 4 years. How much interest he has to pay?

(a) ₹4,371 (b) ₹4,581
(c) ₹14,641 (d) ₹4,641

**[UPPCS, 2012]**

**48.** Rohit invested some amount at the rate of 6 per cent pa and at the end of 3 years he got ₹8730 simple interest. How much compound interest he will get on same amount and same rate of interest after 2 years.

(a) ₹5820 (b) ₹5949.60
(c) ₹5900 (d) ₹5994.60

**[Syndicate Bank PO, 2010]**

**49.** If the compound interest on a certain sum of money for 2 years at 5% is ₹328, then the sum is:

(a) ₹3000 (b) ₹3600
(c) ₹3200 (d) ₹3400

**[SSC, 2014]**

**50.** A man borrows money at 3% per annum interest payable yearly and lend it immediately at 5% interest (compound) payable half-yearly and thereby gains ₹330 at the end of the year. The sum borrowed is:

(a) ₹17,000 (b) ₹16,500
(c) ₹15,000 (d) ₹16,000

**[SSC, 2014]**

**51.** If the compound interest on a sum for 2 years at $12\frac{1}{2}\%$ per cent is ₹510, the simple interest on the same sum at the same rate for same period of time is:

(a) ₹400 (b) ₹450
(c) ₹460 (d) ₹480

**[SSC, 2014]**

**52.** The compound interest on₹5,000 for 3 years at 10% per cent will amount to:

(a) ₹1,654 (b) ₹1,655
(c) ₹1,600 (d) ₹1,565

**[SSC, 2013]**

**53.** What sum will give₹244 as the difference between simple interest and compound interest at 10% in $1\frac{1}{2}$ years compounded half-yearly?

(a) ₹40,000 (b) ₹36,000
(c) ₹32,000 (d) ₹28,000

**[SSC, 2013]**

**54.** A sum of₹3,200 invested at 10% per cent compounded quarterly amounts to₹3,362. Compute the time period.

(a) $\frac{1}{2}$ year (b) 1 year
(c) 2 years (d) $\frac{3}{4}$ year

**[SSC, 2013]**

**55.** If a sum of money compounded annually becomes 1.44 times of itself in 2 years, then the rate of interest per annum is:

(a) 25% (b) 22%
(c) 21% (d) 20%

**[SSC, 2013]**

**56.** An amount of money at compound interest grows up to ₹3,840 in 4 years and up to ₹3,936 in 5 years. Find the rate of interest.

(a) 2.5% (b) 2%
(c) 3.5% (d) 2.05%

**[SSC, 2012]**

**57.** A sum of money at compound interest amounts to thrice itself in 3 years. In how many years will it be 9 times itself?

(a) 9 (b) 27
(c) 6 (d) 3

**[SSC, 2012]**

**58.** Sita deposited ₹5,000 at 10% simple interest for 2 years. How much more money will Sita have in her account at the end of two years, if it is compounded semi-annually?

(a) ₹50 (b) ₹40
(c) ₹77.50 (d) ₹85.50

**[SSC, 2012]**

**59.** If a sum of money placed at compound interest, compounded annually, doubles itself in 5 years, then the same amount of money will be 8 times of itself in

(a) 25 years (b) 20 years
(c) 15 years (d) 10 years

**[SSC, 2011]**

**60.** The compound interest on ₹6250 at 12% per annum for 1 year, compounded half-yearly is:

(a) ₹772.50 (b) ₹772
(c) ₹672.50 (d) ₹672

**[SSC, 2010]**

**61.** A sum of money lent at compound interest amounts to ₹1460 in 2 years and to ₹1606 in 3 years. The rate of interest per annum is:

(a) 12% (b) 11%
(c) 10.5% (d) 10%

**[SSC, 2010]**

**62.** A sum of money, deposited at some rate per cent per annum of compound interest, doubles itself in 4 years. In how many years will it become 16 times of itself at the same rate?

(a) 16 (b) 12
(c) 10 (d) 8

**[SSC, 2010]**

**63.** What is the difference between the compound interest and simple interest on ₹4000 at 5% per annum for 2 years?

(a) 10 (b) 11
(c) 20 (d) 100

**[SSC, 2010]**

**64.** The simple and compound interests on a sum of money for 2 years are ₹8400 and ₹8652 respectively. The rate of interest per annum is:

(a) 6% (b) 7.5%
(c) 9% (d) 4.5%

**[SSC, 2010]**

**65.** Raghu invested a certain sum in Scheme X for 4 years.Scheme X offers simple interest at 12 per cent pa for the firsttwo years and compound interest (compounded annually) at 20 per cent pa for the next two years. The totalinterest earned by him after 4 years is ₹11016. What was the sum invested by Raghu in Scheme X?

(a) ₹17400 (b) ₹18400
(c) ₹16200 (d) ₹11400
(e) ₹9400

**[IBPS PO/MT, 2014]**

**66.** What is the difference between the simple and the compound interest on ₹7,300 at the rate of 6 per cent p.a. in 2 years?

(a) ₹29.37 (b) ₹26.28
(c) ₹31.41 (d) ₹23.22
(e) ₹21.34

**[IBPS PO/MT, 2012]**

**Directions:** In this, question is given followed by data in three statements I, II and III. You have to study the question and the data in statements and decide the question can be answered with data in which of the statements and mark your answer accordingly.

**67.** What is the rate of interest percent p.a.?

**Statements:**

**I.** The difference between the compound interest and simple interest earned in two years on the amount invested is ₹100.

**II.** The amount becomes ₹19,500 in three years on simple interest.

**III.** The simple interest accrued in two years on the same amount at the same rate of interest is ₹3,000.

(a) Only I and II
(b) Only I and III
(c) Only II and III
(d) Only I and either II or III
(e) None of these

**[SBI Associates Banks PO, 2011]**

**68.** The simple interest accrued on a certain principal is ₹2,000 in five years at the rate of 4 percent p.a. What would be the compound interest accrued on the same principal at the same rate in two years?

(a) ₹716 (b) ₹724
(c) ₹824 (d) ₹816
(e) None of these

**[Corporation Bank PO, 2011]**

**69.** Sonika invested an amount of ₹5800 for 2 years. At what rate of compound interest will she get an amount of ₹594.50 at the end of two years?

(a) 5 Percent Pa (b) 4 Percent Pa
(c) 6 Percent Pa (d) 8 Percent Pa
(e) None of these

**[Corporation Bank PO, 2010]**

**70.** What would be the compound interest accrued on an amount of ₹7,400 @ 13.5 per cent pa. at the end of two years? (rounded off to two digits after decimal)

(a) ₹2,136.87 (b) ₹2,306.81
(c) ₹2,032.18 (d) ₹2,132.87
(e) None of these

**[Indian Bank PO, 2010]**

71. If the compound interest accrued on an amount of ₹14,500 in two years is ₹4676.25, what is the rate of interest per cent p.a.?

(a) 11 (b) 9
(c) 15 (d) 18
(e) None of these

**[IDBI Bank PO, 2009]**

**72.** What would be the compound interest accrued on an amount of ₹8000 at the rate of 15 per cent p.a. in three years?

(a) ₹4283 (b) ₹4051
(c) ₹4167 (d) ₹4325
(e) None of these

**[Oriental Bank of Commerce PO, 2009]**

**73.** Manisha invests an amount of ₹39,300 for 4 years atthe rate of 4 per cent p.a. What amount of approximate compound interest will she obtain at the end of 4 years?

(a) ₹6,675 (b) ₹6,650
(c) ₹6,288 (d) ₹6,356
(e) ₹6,450

**[NABARD Bank Officer, 2009]**

## ANSWER KEYS

### Exercise–1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (c) | **3.** (a) | **4.** (b) | **5.** (b) | **6.** (b) | **7.** (a) | **8.** (a) | **9.** (b) | **10.** (b) | **11.** (a) | **12.** (b) | **13.** (c) |
| **14.** (b) | **15.** (c) | **16.** (c) | **17.** (b) | **18.** (a) | **19.** (b) | **20.** (c) | **21.** (a) | **22.** (b) | **23.** (c) | **24.** (a) | **25.** (b) | **26.** (b) |
| **27.** (a) | **28.** (c) | **29.** (a) | **30.** (d) | **31.** (b) | **32.** (a) | **33.** (b) | **34.** (a) | | | | | |

### Exercise–2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (c) | **3.** (b) | **4.** (c) | **5.** (b) | **6.** (c) | **7.** (a) | **8.** (c) | **9.** (b) | **10.** (b) | **11.** (a) | **12.** (c) | **13.** (e) |
| **14.** (d) | **15.** (e) | **16.** (a) | **17.** (a) | **18.** (b) | **19.** (a) | **20.** (b) | **21.** (a) | **22.** (c) | **23.** (e) | **24.** (a) | **25.** (c) | **26.** (c) |
| **27.** (d) | **28.** (c) | **29.** (b) | **30.** (c) | **31.** (b) | **32.** (a) | **33.** (b) | **34.** (c) | **35.** (a) | **36.** (d) | **37.** (d) | **38.** (a) | **39.** (a) |
| **40.** (b) | **41.** (a) | **42.** (a) | **43.** (c) | **44.** (d) | **45.** (b) | **46.** (a) | **47.** (d) | **48.** (d) | **49.** (c) | **50.** (d) | **51.** (d) | **52.** (b) |
| **53.** (c) | **54.** (a) | **55.** (d) | **56.** (a) | **57.** (c) | **58.** (c) | **59.** (c) | **60.** (a) | **61.** (d) | **62.** (a) | **63.** (a) | **64.** (a) | **65.** (c) |
| **66.** (b) | **67.** (c) | **68.** (d) | **69.** (a) | **70.** (d) | **71.** (c) | **72.** (c) | **73.** (a) | | | | | |

# EXPLANATORY ANSWERS

## EXERCISE-1

**1. (a)** Here, $P$ = 8000, $t$ = 3 and $R$ = 5.

$\therefore$ Amount $= P\left(1+\frac{R}{100}\right)^t = 8000\left(1+\frac{5}{100}\right)^3$

$= 8000\left(\frac{21}{20}\right)^3 = \frac{8000\times 21\times 21\times 21}{20\times 20}$

= ₹9261.

$\therefore$ Nikita will get ₹9261 after 3 years.

**2. (c)** Here, $P$ = 2000, $R$ = 5 and $t$ = 2.

$$\therefore \quad \text{CI} = P\left[\left(1+\frac{R}{100}\right)^t - 1\right]$$

$$= 2000\left[\left(\frac{21}{20}\right)^2 - 1\right] = 2000\left[\left(\frac{21}{20}\right)^2 - 1\right]$$

$$= 2000\left(\frac{441}{400} - 1\right) = 2000 \times \frac{41}{400} = ₹205.$$

**3. (a)** Here, $P$ = 1000, $A$ = 1331 and $t$ = 3.

$$P = 100\left[\left(\frac{A}{P}\right)^{1/t} - 1\right]\% \text{ p.a.}$$

$$= 100\left[\left(\frac{1331}{1000}\right)^{1/3} - 1\right]\% \text{ p.a.}$$

$$= 100\left[\left(\frac{11}{10}\right)^{3\times\frac{1}{3}} - 1\right] = 100 \times \frac{1}{10} = 10\% \text{ p.a.}$$

**4. (b)** Here, $A$ = 9261, $t$ = 3 and $R$ = 5.

$$\therefore \quad P = \frac{A}{\left(1+\frac{R}{100}\right)^t} = \frac{9261}{\left(1+\frac{5}{100}\right)^3}$$

$$= \frac{9261\times 20\times 20\times 20}{21\times 21\times 21} = ₹8000.$$

**5. (b)** Here, $P$ = 10000, $R$ = 20 and $t = \frac{3}{2}$.

$$\therefore \quad \text{CI} = P\left[\left(1+\frac{R}{100\times 2}\right)^{2t} - 1\right]$$

$$= 10000\left[\left(1+\frac{20}{100\times 2}\right)^{2\times\frac{3}{2}} - 1\right]$$

$$= 10000\left[\left(\frac{11}{10}\right)^3 - 1\right]$$

$$= 10000\left(\frac{11\times 11\times 11}{10\times 10\times 10} - 1\right)$$

$$= \frac{10000\times 331}{1000} = ₹3310.$$

**6. (b)** Let ₹$x$ be the sum. Then,

$$6632.55 = x\left(1+\frac{4}{2\times 100}\right)^{2\times\frac{3}{2}} = x\left(\frac{51}{50}\right)^3$$

$$\therefore \quad x = \frac{6632\cdot 55\times 50\times 50\times 50}{51\times 51\times 51} = ₹6250.$$

**7. (a)** Here, $P$ = 12000, $R$ = 20 and $t = \frac{9}{12}$

$$\therefore \quad \text{CI} = P\left[\left(1+\frac{R}{100\times 4}\right)^{4\times t} - 1\right]$$

$$= 12000\left[\left(1+\frac{20}{100\times 4}\right)^{4\times\frac{9}{12}} - 1\right]$$

$$= 12000\left[\left(1+\frac{1}{20}\right)^3 - 1\right] = \frac{12000\times 1261}{20\times 20\times 20}$$

= ₹1891·50.

**8. (a)** When compounded half-yearly:

Here, $P$ = 800, $R$ = 20 and $t$ = 1.

$$\therefore \quad \text{CI} = P\left[\left(1+\frac{R}{100\times 2}\right)^{2\times t} - 1\right]$$

$$= 800\left[\left(1+\frac{20}{100\times 2}\right)^{2\times 1} - 1\right]$$

$$= 800\left[\left(\frac{11}{10}\right)^2 - 1\right] = \frac{800\times 21}{10\times 10} = ₹168.$$

When compounded quarterly:

Here, $P$ = 8000, $R$ = 20 and $t$ = 1.

$$\therefore \quad \text{CI} = P\left[\left(1+\frac{R}{100\times 4}\right)^{4\times t} - 1\right]$$

$$= 800\left[\left(1+\frac{20}{100\times 4}\right)^{4\times 1} - 1\right]$$

$$= 800\left[\left(\frac{21}{20}\right)^4 - 1\right] = \frac{800\times 34481}{20\times 20\times 20\times 20}$$

= ₹172.40.

$\therefore$ Difference = ₹(172.40 − 168) = ₹4.40.

**9.** **(b)** SI = $\dfrac{600\times10\times1}{100}$ = ₹60.

$$CI = 600\left[\left(1+\frac{10}{100\times2}\right)^{2\times1}-1\right]$$

$$= 600\left[\left(\frac{21}{20}\right)^{2}-1\right]=\frac{600\times41}{20\times20} = ₹61\cdot50$$

∴ Difference = ₹(61.50 − 60) = ₹1.50.

**10.** **(b)** Let the time be $t$ years. Then,

$$882 = 800\left(1+\frac{5}{100}\right)^{t} \Rightarrow \frac{882}{800}=\left(\frac{21}{20}\right)^{t}$$

$$\Rightarrow \left(\frac{21}{20}\right)^{2}=\left(\frac{21}{20}\right)^{t}$$

$\Rightarrow t$ = 2 years.

**11.** **(a)** Here, $P$ = 1875, $R_1$ = 4 and $R_2$ = 8.

$$\therefore\ CI = P\left[\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)-1\right]$$

$$= 1875\left[\left(1+\frac{4}{100}\right)\left(1+\frac{8}{100}\right)-1\right]$$

$$= 1875\left[\frac{26}{25}\times\frac{27}{25}-1\right]$$

$$= \frac{1875\times77}{625} = ₹231.$$

**12.** **(b)** Here, $P$ = 5000, $R_1$ = 2, $R_2$ = 3 and $R_3$ = 4.

∴ Amount after 3 years

$$= P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)\left(1+\frac{R_3}{100}\right)$$

$$= 5000\left(1+\frac{2}{100}\right)\left(1+\frac{3}{100}\right)\left(1+\frac{4}{100}\right)$$

$$= 5000\times\frac{51}{50}\times\frac{103}{100}\times\frac{26}{25}$$

= ₹5463·12.

**13.** **(c)** Let, ₹$P$ be the required sum.

Then, $15916.59 = P\left(1+\dfrac{3}{100}\right)\left(1+\dfrac{2}{100}\right)\left(1+\dfrac{1}{100}\right)$

$$= P\left(\frac{103}{100}\times\frac{102}{100}\times\frac{101}{100}\right).$$

$$\therefore\ P = \frac{1591659\times100\times100}{103\times102\times101}$$

= ₹15000.

**14.** **(b)** $CI = 800\left[\left(1+\dfrac{5}{100}\right)^{2}\left(1+\dfrac{\frac{1}{2}\times5}{100}\right)-1\right]$

$$= 800\left[\frac{21\times21\times41}{20\times20\times40}-1\right]=\frac{800\times2081}{16000}$$

= ₹104.05.

**15.** **(c)** We have, $6352\cdot50 = P\left(1+\dfrac{10}{100}\right)^{2}\left(1+\dfrac{\frac{1}{2}\times10}{100}\right)$

$$= P\left(\frac{11}{10}\right)^{2}\left(\frac{21}{20}\right)$$

$$\Rightarrow P = \frac{6352\cdot50\times10\times10\times20}{11\times11\times21} = ₹5000.$$

**16.** **(c)** We have, $CI - SI = \dfrac{SI}{3}\left[\left(\dfrac{R}{100}\right)^{2}+3\left(\dfrac{R}{100}\right)\right]$

$$\Rightarrow 11324\cdot05 - SI = \frac{SI}{3}\left[\left(\frac{5}{100}\right)^{2}+3\left(\frac{5}{100}\right)\right]$$

$$= \frac{SI}{3}\left[\frac{1+60}{20\times20}\right]=\frac{61SI}{1200}$$

$$\Rightarrow \left(1+\frac{61}{1200}\right)SI = 1324\cdot05$$

$$\Rightarrow SI = \frac{1324\cdot05\times1200}{1261} = ₹1260.$$

**17.** **(b)** We have, $CI - SI = \dfrac{R\times SI}{200}$

$$\Rightarrow CI = SI + \frac{R\times SI}{200} = SI\left(1+\frac{R}{200}\right) = 80\left(1+\frac{4}{200}\right)$$

[Here, $R$ = 4 and $SI$ = 80]

$$= \frac{80\times51}{50} = ₹81.60.$$

**18.** **(a)** We have,

$$CI - SI = \frac{R\times SI}{200}$$

$$\Rightarrow 60.60 - 60 = \frac{R\times60}{200}$$

$$\Rightarrow R = \frac{0\cdot60\times200}{60} = 2\%$$

**19.** **(b)** We have,

$$CI - SI = \frac{R\times SI}{200} \Rightarrow 105 - 100 = \frac{R\times100}{200}$$

$\Rightarrow R$ = 10.

Also, $CI - SI = P\left(\dfrac{R}{100}\right)^{2} \Rightarrow 105 - 100 = P\left(\dfrac{10}{100}\right)^{2}$

$\Rightarrow P$ = ₹500.

**20.** **(c)** We have,

$$\text{CI} - \text{SI} = P\left(\frac{R}{100}\right)^2 = 1250\left(\frac{4}{100}\right)^2$$

[Here, $P$ = 1250 and $R$ = 4]

$$= \frac{1250}{15 \times 25} = ₹2.$$

**21.** **(a)** We have,

$$\text{CI} - \text{SI} = \frac{R \times \text{SI}}{200} = \frac{7 \times 200}{200}$$

[Here, $R$ = 7 and $SI$ = 200]

$$= ₹7.$$

**22.** **(b)** We have,

$$\text{CI} - \text{SI} = P\left(\frac{R}{100}\right)^2$$

$$\Rightarrow \frac{3}{2} = P\left(\frac{5}{100}\right)^2 \qquad \left[\text{Here, CI} - \text{SI} = \frac{3}{2} \text{ and } R = 5\right]$$

$$\Rightarrow P = \frac{3 \times 20 \times 20}{2} = ₹600.$$

**23.** **(c)** We have, $\text{CI} - \text{SI} = P\left[\left(\frac{R}{100}\right)^3 + 3\left(\frac{R}{100}\right)^2\right]$

$$\Rightarrow 27.27 = P\left[\left(\frac{3}{100}\right)^3 + 3\left(\frac{3}{100}\right)^2\right]$$

[Here, CI – SI = 27–27 and $R$ = 3]

$$= P\left[\frac{27 + 2700}{100 \times 100 \times 100}\right]$$

$$\Rightarrow P = \frac{27 \cdot 27 \times 100 \times 100 \times 100}{2727}$$

$$= ₹10000.$$

**24.** **(a)** We have,

$$\text{CI} - \text{SI} = P\left[\left(\frac{R}{100}\right)^3 + 3\left(\frac{R}{100}\right)^2\right]$$

$$= 8000\left[\left(\frac{5}{100}\right)^3 + 3\left(\frac{5}{100}\right)^2\right]$$

[Here, $P$ = 8000 and $R$ = 5]

$$= 8000\left[\frac{125 + 7500}{100 \times 100 \times 100}\right] = ₹61.$$

**25.** **(b)** Here, $n$ = 3, $t$ = 3 and $m$ = 2.

∴ The given sum will become 9 times itself in $mt$, i.e., 2 × 3 = 6 years.

**26.** **(b)** The required rate per cent is

$R = 100[(n)^{1/t} - 1] = 100[(16)^{1/4} - 1]$

[Here, $n$ = 16 and $t$ = 4]

$= 100(2 - 1) = 100\%.$

**27.** **(a)** Here, $x$ = 12960, $y$ = 13176, $A$ = 2 and $B$ = 3.

$$\therefore \quad R = \left[\left(\frac{y}{x}\right)^{1/B-A} - 1\right] \times 100\%$$

$$= \left(\frac{13176}{12960} - 1\right) \times 100\%$$

$$= \left(\frac{216}{12960} \times 100\right)\%$$

$$= \frac{4}{3}\% \text{ or } 1\frac{1}{3}\%$$

**28.** **(c)** Here, $x$ = 650, $y$ = 676, $A$ = 1 and $B$ = 2.

$$\therefore \text{ Rate of interest} (R) = \left[\left(\frac{y}{x}\right)^{1/B-A} - 1\right] \times 100\%$$

$$= \left[\frac{676}{650} - 1\right] \times 100\%$$

$$= \frac{26}{650} \times 100\% = 4\%.$$

$$\therefore \quad 650 = P\left(1 + \frac{4}{100}\right) \Rightarrow P = \frac{650 \times 25}{26} = ₹625.$$

**29.** **(a)** Here, $P$ = 1260 and $R$ = 10.

∴ Annual instalment

$$= \frac{P}{\left(\frac{100}{100+R}\right) + \left(\frac{100}{100+R}\right)^2} = \frac{1260}{\frac{100}{110} + \left(\frac{100}{110}\right)^2}$$

$$= \frac{1260}{\frac{100}{110}\left(1 + \frac{100}{110}\right)} = 1260 \times \frac{110}{100} \times \frac{110}{210} = ₹726.$$

**30.** **(d)** Increase % = $\left(\frac{1}{8} \times 100\right)\%$ = 12.5%

$$\text{Height after 2 years} = 64 \times \left(1 + \frac{25}{2 \times 100}\right)^2 = 64 \times \frac{9}{8} \times \frac{9}{8}$$

$$= 81 \text{ cm}.$$

**31.** **(b)** $x\left(1 + \frac{20}{100}\right)^n > 2x$ or $\left(\frac{6}{5}\right)^n > 2$

Now, $\left(\frac{6}{5} \times \frac{6}{5} \times \frac{6}{5} \times \frac{6}{5}\right) > 2 \quad \therefore n = 4$ years.

**32.** **(a)** Balance $= ₹\left[\left\{4000 \times \left(1 + \frac{15}{2 \times 100}\right)^3\right\}\right.$

$$\left. - \left\{1500 \times \left(1 + \frac{15}{2 \times 100}\right)^2 + 1500 \times \left(1 + \frac{15}{2 \times 100}\right) + 1500\right\}\right]$$

= ₹123·25.

**33.** **(b)** Let, $r$% be the rate and $n$ years be the time.

Then, $4320 = 3000\left(1 + \frac{r}{100}\right)^n$

$\therefore \quad \left(1+\frac{r}{100}\right)^n = \frac{4320}{3000} = 1.44$

$\therefore \quad \left(1+\frac{r}{100}\right)^{n/2} = \sqrt{1.44} = 1.2$

$\therefore$ In $\frac{n}{2}$ years, ₹3000 will amount to

$3000\left(1+\frac{r}{100}\right)^{n/2} = 3000 \times 1.2$

$= ₹3600.$

**34. (a)** Let A's share = ₹$x$

B's share = ₹$(3757 - x)$

$x\left(1+\frac{10}{100}\right)^7 = (3757 - x)\left(1+\frac{10}{100}\right)^9$

$x = (3757 - x)\left(\frac{11}{10}\right)^2$

$\therefore \quad x\left(1+\frac{121}{100}\right) = \frac{3757 \times 121}{100}$

$\therefore \quad x = \frac{375 \times 121}{221}$

$= ₹2057$

$\therefore$ B's share = ₹(3757 − 2057) = ₹1700.

## Exercise-2
## (Based on Memory)

**1. (c)** Let the sum be ₹$x$

$\therefore \quad x\left(1+\frac{R}{100}\right)^2 = 4500 \quad \cdots(1)$

$x\left(1+\frac{R}{100}\right)^4 = 6750$

$\therefore \quad \left(1+\frac{R}{100}\right)^2 = \frac{6750}{4500}$

$\left(1+\frac{R}{100}\right)^2 = \frac{135}{90} = \frac{3}{2} \quad \cdots(2)$

(1) and (2)

$\Rightarrow \frac{4500}{x} = \frac{3}{2} \Rightarrow x = 3000$

**2. (c)** $\Rightarrow \left(1+\frac{R}{100}\right)^2 = \frac{2500}{2304} = \frac{1250}{1152} = \frac{625}{576}$

$\Rightarrow 1+\frac{R}{100} = \frac{25}{4} \Rightarrow \frac{R}{100} = \frac{1}{24}$

$\Rightarrow R = \frac{100}{24} = \frac{25}{6} = 4\frac{1}{6}\%$

**3. (b)** Let the sum be ₹100

$\therefore$ SI = $\frac{100 \times 2 \times 4}{100} = ₹8$

CI = $100\left(1+\frac{4}{100}\right)^2 - 100$

$= 100 \times \frac{26}{25} \times \frac{26}{25} - 100$

$= \frac{100 \times 51}{25 \times 25} = \frac{204}{25}$

CI − SI = $\frac{204}{25} - 8 = \frac{4}{25}$

If the difference is ₹ $\frac{4}{25}$,

then the sum = ₹100

If the difference is ₹1, then

the sum = $\frac{100 \times 25}{4} = 625$

**5. (b)** Let the money invested by $M_{nx}$ in scheme 'A' be ₹$K$

$\therefore$ Money invested in 'B' = ₹$(35000 - K)$

$\because \quad \frac{K \times 12 \times 2}{100} = 3600$

$\therefore \quad K = \frac{3600 \times 100}{12 \times 2} = ₹15000$

$\Rightarrow$ 35000 − $K$ = ₹20000

$\therefore$ Interest accrued in scheme 'B'

$= 20000\left[\left(1+\frac{10}{100}\right)^2 - 1\right]$

$= 20000 \times \frac{121-100}{100} = ₹4200$

**6. (c)** In case of simple interest, the total interest for two years is (5 + 5 =) 10% of the principal amount, whereas at compound interest the total interest for two years is $\left(5+5+\frac{5\times5}{100}=\right)$ 10.25% of the principal amount.

Hence we can conclude that ₹35 is (10.25 − 10=) 0.25% of the principal amount.

Hence the required amount

$= \frac{35 \times 100}{0.25} = ₹14000$

7. **(a)** The required interest

$$= 15000\left(1+\frac{15}{100}\right)^3 - 15000$$

$$= 15000 \times \frac{23\times 23\times 23}{20\times 20\times 20} - 15000$$

= 15000 ×0.520875 = ₹7813.125

8. **(c)** Under the scheme X, the interest obtained is $\left(10+10+\frac{10\times 10}{100}=\right)$ 21% of the sum.

Whereas under the scheme Y, the interest obtained is $\left(12+12+\frac{12\times 12}{100}=\right)$ 25.44% of the sum.

Now, 21% of the sum = ₹63

∴ 25.44% of the sum = $\frac{63}{21}\times 25.44$ = ₹76.32

9. **(b)** Rate of interest $= \frac{5580\times 100}{15500\times 3} = 12\%$

After compounding 12% for 3 years, the equivalent rate of simple interest = 40.4928%.

Now, $(12\times 3 =)\ 36\% = 5580$

∴ 40.4918% $= \frac{5580}{36}\times 40.4928 = ₹6276.384$

Remember that at the rate of 12% the difference in SI and CI after 3 years = 40.4928 – 36 = 4.4928% of the principal.

10. **(b)** Equivalent % interest for compound rate of interest of 8% for 2 years

$$= 2\times 8 + \frac{8^2}{100} = 16.64\%$$

So, interest = 16.64% of 3980 ≈ 665

11. **(a)** Required difference = 12% of 12% of 960

$$= \frac{12}{100}\times\frac{12}{100}\times 960 = ₹13.824$$

12. **(c)** We know Rate %

$$= \frac{\text{Interest}\times 100}{\text{Amount}\times\text{Time}} = \frac{6216\times 100}{14800\times 3} = 14\%$$

Now the required compound interest

$$= 14800\times\left(1+\frac{14}{100}\right)^3 - 14800$$

= ₹7126.8512

13. **(e)** 5% rate of CI for 2 years $= 5\times 2 + \frac{5\times 5}{100}$

= 10.25% rate of SI for 1 year.

∴ 10.25% of 4890 = 10% of 4890 + 0.25% of

$$4890 = 489 + 0.25\times 48.9 = 489 + \frac{48.9}{4} \approx 501$$

14. **(d)** CI $= 41250\left[\left(1+\frac{6}{100}\right)^3 - 1\right]$

$$= 41250\left[\left(\frac{53}{50}\right)^3 - 1\right]$$

$$= 41250\left(\frac{53\times 53\times 53 - 50\times 50\times 50}{50\times 50\times 50}\right)$$

$$= 41250\left(\frac{148857-125000}{125000}\right)$$

$$= \frac{41250\times 23877}{125000} = ₹7879$$

15. **(e)** We know that for 2 years the difference in CI from SI is due to interest on interest of first year. That is, the difference

= 14% of 14% of 985

$$= \frac{14\times 14\times 985}{100\times 100} = ₹19.306$$

16. **(a)** Simple interest equivalent to compound interest for 3 years @ 15% is calculated as follows:

For 2 years

$$= 2\times 15 + \frac{15^2}{100} = 30 + 2.25 = 32.25$$

For 3 years $= 32.25 + 15 + \frac{32.25\times 15}{100}$

= 47.25 + 4.8375 = 52.0875%

∴ % difference in CI and SI

$= 52.0875 - 15\times 3 = 7.0875\%$

⇒ 7.0875% of amount = 595.35

∴ Amount $= \frac{595.35\times 100}{7.0875} = ₹8400$

17. **(a)** Let each instalment be ₹$x$

∴ $x = P_1\left(1+\frac{4}{100}\right)^t \Rightarrow P_1 = \left(\frac{25}{26}\right)^2 x$

Similarly, $P_2 = \left(\frac{25}{26}\right)^2 \cdot x$

∴ $\left(\frac{25}{26}\right)x + \left(\frac{25}{26}\right)^2 x = 2550 \Rightarrow x = \frac{2550\times 26\times 26}{25\times 51}$

$x$ = ₹1352.

18. **(b)** $3993 = 3000\left(1+\frac{R}{100}\right)^3$

$$\Rightarrow \frac{1331}{1000} = \left(1+\frac{R}{100}\right)^3 \Rightarrow \left(1+\frac{R}{100}\right)^3 = \left(\frac{11}{10}\right)^3$$

$$\Rightarrow 1 + \frac{R}{100} = \frac{11}{10} \Rightarrow 1 + \frac{R}{100} = 1 + \frac{1}{10}$$

$\Rightarrow \dfrac{R}{100} = \dfrac{1}{10}$

$\Rightarrow R = 10.$

**19. (a)** Let instalment = ₹$x$

$\therefore \left(\dfrac{20}{21}\right)x + \left(\dfrac{20}{21}\right)^2 x = 1025$

$\Rightarrow \left(\dfrac{20}{21}\right)x\left[1+\dfrac{20}{21}\right] = 1025$

$\Rightarrow x = \dfrac{1025\times 21\times 21}{20\times 41}$ = ₹551.25.

**20. (b)** $A = P\left(1+\dfrac{R}{100}\right)^n = 10000\left(1+\dfrac{2}{100}\right)^4$

$= 10000 \times \dfrac{51}{50}\times\dfrac{51}{50}\times\dfrac{51}{50}\times\dfrac{51}{50}$

= ₹10824.32

Compound Interest = ₹10824.32 – ₹10000

= ₹824.32.

**21. (a)** Compound interest in one year

$= P\left(1+\dfrac{6}{100}\right)^2 - P$

$= \dfrac{2809}{2500}P - P = \dfrac{309}{2500}P$

Simple interest in one year = $\dfrac{P\times 12\times 1}{100} = \dfrac{2}{25}P$

Then, $\dfrac{309}{2500}P - \dfrac{3}{25}P = 36 = \dfrac{309P-300P}{2500} = 26$

$= \dfrac{9}{2500}P = 36$

$\therefore \quad P = \dfrac{36\times 2500}{9}$

= ₹10000.

**23. (e)** Required difference

$= 5000\left(1+\dfrac{2}{100}\right)^3 - 5000\left(1+\dfrac{4}{100}\right)^{3/2}$

= 5306.04 – 5252 = ₹54.04.

**24. (a)** $P\left(1+\dfrac{25}{400}\right)^3 = 4913$

$\Rightarrow P = 4913 \times \dfrac{16}{17}\times\dfrac{16}{17}\times\dfrac{16}{17} = 4096.$

**25. (c)** $P\left(1+\dfrac{5}{100}\right)^2 = 441$

$\Rightarrow P = 441 \times \dfrac{20}{21}\times\dfrac{20}{21} = 400.$

**26. (c)** $P\left(1+\dfrac{R}{100}\right)^2 - P = 618$

$\dfrac{P\times R\times 2}{100} = 600$

Solving these equations, we get $R = 6$.

**27. (d)** $100\left(1+\dfrac{3}{100}\right)^2 = 100 \times \dfrac{103}{100}\times\dfrac{103}{100} = 106.09.$

**28. (c)** Sum = Difference$\left(\dfrac{100}{R}\right)^2$

$\therefore$ Sum = $1\left(\dfrac{100}{R}\right)^2$ = ₹625.

**29. (b)** $P\left(1+\dfrac{R}{100}\right)^4 = 2P$

$\therefore \left(1+\dfrac{R}{100}\right)^4 = 2$

Cubing both sides, we get

$\left(1+\dfrac{R}{100}\right)^{12} = 8$ or, $P\left(1+\dfrac{R}{100}\right)^{12} = 8P.$

**30. (c)** Let the sum be $P$

$\left[P\left(1+\dfrac{5}{100}\right)^2 - P\right] - \dfrac{P\times 2\times 5}{100} = 15$

$\therefore$ $P$ = ₹6000.

**31. (b)** Let the sum be $P$, rate be $r$% and required time be $t$ years.

Then, from the equation,

$2P = P\left(1+\dfrac{R}{100}\right)^{10}$ or, $\left(1+\dfrac{R}{100}\right)^{10} = 2$

Again, $4P = P\left(1+\dfrac{R}{100}\right)^t$ or, $4 = \left[\left(1+\dfrac{R}{100}\right)^{10}\right]^{\frac{t}{10}}$

or $2^{\frac{t}{10}} = 4 = 2^2$ or, $\dfrac{t}{10} = 2$

$\therefore$ $t = 20$ years.

**32. (a)** $2400 = P\left(1+\dfrac{R}{100}\right)^3 \quad \cdots(1)$

$2520 = P\left(1+\dfrac{R}{100}\right)^4 \quad \cdots(2)$

Equation (1) ÷ Equation (2), gives

$\dfrac{2400}{2520} = \dfrac{\left(1+\dfrac{R}{100}\right)^3}{\left(1+\dfrac{R}{100}\right)^4}$

or, $\frac{20}{21} = \frac{1}{1+\frac{R}{100}}$ or, $20 + \frac{R}{5} = 21$

$\therefore$ $R = 5\%$

**34. (c)** Interest on ₹800 is ₹40 (after 1 year).

**35. (a)** Let time be $n$ years

i.e., $1000\left(1+\frac{10}{100}\right)^{2n} = 1331$

or, $\left(\frac{11}{10}\right)^{2n} = \frac{1331}{1000} = \left(\frac{11}{10}\right)^{3}$

or, $2n = 3$ or, $n = 1\frac{1}{2}$ years.

**36. (d)** Sum = Difference $\left(\frac{100}{R}\right)^2 = 65\left(\frac{100}{10}\right)^2$

$= 65(100) =$ ₹6500.

**37. (d)** Principle $= \frac{1000\times100}{5\times4} =$ ₹5000

Compound interest $= 10000\left[\left(1+\frac{5}{100}\right)^2 - 1\right]$

$= 10000 \times \frac{41}{100} =$ ₹1025

**38. (a)** $594.5 = 5800\left[\left(1+\frac{r}{100}\right)^2\right] - 1$

$\frac{594.5}{5800} = \left(1+\frac{r}{100}\right)^2 - 1$

$0.1025 + 1 = \left(1+\frac{r}{100}\right)^2$

$1.1025 = \frac{(100+r)^2}{10000}$

$1.1025 \times 10000 = (100 + r)^2$

$11025 = (100 + r)^2$

$(105)^2 = (100 + r)^2$

$105 = 100 + r$

$r = 5\%$

**39. (a)** $R = \frac{\text{S.I.}\times100}{P\times T}$

$= \frac{10230\times100}{27500\times3} = 12.4\%$ p.q.

$\text{CI} = P\left[\left(1+\frac{r}{100}\right)^t - 1\right]$

$= 27500\left[\left(1+\frac{12.4}{100}\right)^3 - 1\right]$

$= 27500\left[\left(\frac{112.4}{100}\right)^3 - 1\right]$

$= 27500\left[\frac{112.4\times112.4\times112.4 \\ -100\times100\times100}{100\times100\times100}\right]$

$= 27500\left[\frac{1420034.624+1000000}{1000000}\right]$

$= 27500\left[\frac{420034.624}{1000000}\right]$

$= 27500 \times 0.42$

$=$ ₹11550

**40. (b)** When interest was compounded half-yearly then

$R = \frac{20}{2} = 10\%$

$T = 2$ units for 1 year

Accumalated interest in 2 years

$= \left\{20000\left(1+\frac{10}{100}\right)^2\left(1+\frac{20}{100}\right)\right\} - 20000$

$= \left\{20000\times\frac{11}{10}\times\frac{11}{10}\times\frac{6}{5}\right\} - 20000$

$= 29040 - 20000$

$=$ ₹9040

**41. (a)** Rate of interest = 10% per annum. So, rate of interest for half-yearly = 5%

Therefore, $A = P\frac{(1+R)^T}{100}$

$926.10 = 800\frac{(1+5)^T}{100}$

$926.10 = 800\frac{(100+5)^T}{100}$

$926.10 = 800\frac{(21)^T}{20}$

$\frac{926.1\times10}{8000\times10} = \left(\frac{21}{20}\right)^T$

$\frac{9261}{8000} = \left(\frac{21}{20}\right)^T$

$\left(\frac{21}{20}\right)^3 = \left(\frac{21}{20}\right)^T$

Hence, time = 3 half-years

$= 1\frac{1}{2}$ years

**42. (a)** Suppose the principle is ₹$x$.

$x\left[\frac{6}{100}+\frac{6.5}{100}+\frac{7.0}{100}+\frac{7.5}{100}\right] = 3375$

$\frac{x}{100}\times27 = 3375$

$$x = \frac{3375 \times 100}{27}$$

$= ₹12500$

**43**. **(c)** Required time $= \dfrac{4 \times \log 4}{\log 2}$ = 8 years

**44. (d)** $A = P\left(1+\dfrac{R}{100}\right)^T$

$$\Rightarrow \frac{A}{P} = \left(1+\frac{R}{100}\right)^T$$

$$\Rightarrow 2 = \left(1+\frac{R}{100}\right)^S$$

$$\Rightarrow 2^4 = \left(1+\frac{R}{100}\right)^{20}$$

$$\Rightarrow 16 = \left(1+\frac{R}{100}\right)^{20}$$

Hence, the principal will become 16 times in 20 years.
= ₹(16 × 12000)
= ₹1,92,000

**45. (b)** Difference $=\left(\dfrac{Pr^2}{100}\right)$

$$\Rightarrow 6\times\frac{P\times5\times5}{10000} \quad \Rightarrow \quad 25P = 6000$$

$$\Rightarrow P = \frac{6000}{25} = ₹2400$$

**46. (a)** It becomes 2 times in 15 years.
It becomes 4 times in 30 years.
It becomes 8 times in 45 years.

**47. (d)** Required interest

$$= 10000\left(1+\frac{10}{100}\right)^4 - 10000$$

$$= ₹10000\times\frac{(11)^4}{10000}10000$$

= ₹(14641 − 10000)
= ₹4641

**48. (d)** Principle $= \dfrac{8730\times100}{6\times3} = 48500$

Compound interest

$$= 48500\left[\left(1+\frac{6}{100}\right)^2 - 1\right]$$

= 48500 × 0.1236
= ₹5994.60

**49. (c)** Let the principal be ₹$P$. Then,

$$\text{CI} = P\left[\left(1+\frac{R}{100}\right)^2 - 1\right]$$

$$\Rightarrow 328 = P\left[\left(1+\frac{5}{100}\right)^2 - 1\right] = P\left[\left(\frac{21}{20}\right)^2 - 1\right]$$

$$\Rightarrow 328 = P\left(\frac{441}{400} - 1\right) = P\left(\frac{441-400}{400}\right) = P\left(\frac{41}{400}\right)$$

$$\Rightarrow P = \frac{328\times400}{41} = \text{‘}3200$$

**50. (d)** Let the amount borrowed be ₹$x$.

$\therefore$ Interest to be paid $= ₹\dfrac{x\times3}{100} = ₹\dfrac{3x}{100}$

Case II,

Rate $= \dfrac{5}{2}$% per half-year

Time = 2 half-years

$$\therefore \text{CI} = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$$

$$= x\left[\left(1+\frac{5}{200}\right)^2 - 1\right] = x\left[\left(1+\frac{1}{40}\right)^2 - 1\right]$$

$$= x\left[\left(\frac{41}{40}\right)^2 - 1\right] = x\left[\left(\frac{1681}{1600} - 1\right)\right]$$

$$= x\left(\frac{1681-1600}{1600}\right) = ₹\frac{81x}{1600}$$

$$\text{Difference} = \frac{81x}{1600} - \frac{3x}{100}$$

$$= \frac{81x - 48x}{1600} = ₹\frac{33x}{1600}$$

$$\therefore \frac{33x}{1600} = 330$$

$$\Rightarrow x = \frac{1600\times330}{33} = ₹16000$$

**51. (d)** Let the principal be ₹$P$.

$$\therefore \text{CI} = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$$

$$\Rightarrow 510 = P\left[\left(1+\frac{25}{100}\right)^2 - 1\right]$$

$$\Rightarrow 510 = P\left[\left(1+\frac{1}{8}\right)^2 - 1\right]$$

$$\Rightarrow 510 = P\left[\left(\frac{9}{8}\right)^2 - 1\right]$$

$$\Rightarrow 510 = P\left(\frac{81}{64} - 1\right)$$

$$\Rightarrow \quad 510 = P\left(\frac{81-64}{64}\right) = \frac{17P}{64}$$

$$\Rightarrow \quad P = \frac{510 \times 64}{17} = ₹1920$$

$$\therefore \quad \text{SI} = \frac{\text{Principal} \times \text{Time} \times \text{Rate}}{100}$$

$$= \frac{1920 \times 2 \times 25}{100 \times 2} = ₹480$$

**52. (b)** $\text{CI} = P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = 5000\left[\left(1+\frac{10}{100}\right)^3 - 1\right]$

$$= 5000\left[\left(\frac{11}{10}\right)^3 - 1\right] = \frac{5000 \times 331}{1000} = ₹1655$$

**53. (c)** $\text{Difference} = P\left(\frac{r^3}{1000000} + \frac{3r^3}{10000}\right)$

$$\Rightarrow \quad 244 = P\left(\frac{125}{1000000} + \frac{75}{10000}\right)$$

$$\Rightarrow \quad 244 = P\left(\frac{7625}{1000000}\right)$$

$$\Rightarrow \quad P = \frac{244 \times 1000000}{7625} = 32000$$

**54. (a)** $A = P\left(1+\frac{R}{100}\right)^T \quad \Rightarrow \quad \frac{3362}{3200} = \left(1+\frac{10}{400}\right)^{4t}$

$$\Rightarrow \quad \frac{1681}{1600} = \left(\frac{41}{40}\right)^{4t} \quad \Rightarrow \quad \left(\frac{41}{40}\right)^2 = \left(\frac{41}{40}\right)^{4t}$$

$$\Rightarrow \quad 4t = 2 \quad \Rightarrow \quad t = \frac{1}{2} \text{ year}$$

**55. (d)** $A = P\left(1+\frac{R}{100}\right)^T \quad \Leftrightarrow \quad 1.44\,P = P\left(1+\frac{R}{100}\right)^2$

$$\Rightarrow \quad (1.2)^2 = \left(1+\frac{R}{100}\right)^2$$

$$\Rightarrow \quad 1+\frac{R}{100} = 1.2 \quad \Leftrightarrow \quad R = 0.2 \times 100 = 20\%$$

**56. (a)** $A = P\left(1+\frac{R}{100}\right)^T$

$$\therefore \quad 3840 = P\left(1+\frac{R}{100}\right)^4 \qquad \cdots(1)$$

$$3936 = P\left(1+\frac{R}{100}\right)^5 \qquad \cdots(2)$$

Dividing equation (2) by equation (1), we have

$$\frac{3936}{3840} = 1+\frac{R}{100} \quad \Rightarrow \quad \frac{R}{100} = \frac{3936}{3840} - 1$$

$$= \frac{3936-3840}{3840} = \frac{96}{3840}$$

$$\Rightarrow \quad R = \frac{96}{3840} \times 100 = 2.5\%$$

**57. (c)** $A = P\left(1+\frac{R}{100}\right)^T$

$$\Rightarrow \quad 3 = 1\left(1+\frac{R}{100}\right)^3$$

On squaring both sides,

$$9 = 1\left(1+\frac{R}{100}\right)^6$$

Clearly, the required time = 6 years

**58. (c)** Rate = 5%, Time = 4 half-years

$$\therefore \quad \text{CI} = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$$

$$= 5000\left[\left(1+\frac{5}{100}\right)^4 - 1\right]$$

$$= 5000\left(\frac{194481}{160000} - 1\right)$$

$$= \frac{5000 \times 34481}{160000} = ₹1077.5$$

$$\text{SI} = \frac{5000 \times 10 \times 2}{100} = ₹1000$$

Difference = 1077.5 − 1000 = ₹77.5

**59. (c)** Let the principal be ₹1.

$$\therefore \quad A = P\left(1+\frac{R}{100}\right)^T$$

$$\Rightarrow \quad 2 = 1\left(1+\frac{R}{100}\right)^5$$

Cubing both sides,

$$2^3 = \left(1+\frac{R}{100}\right)^{5\times 3}$$

$$\Rightarrow \quad 2^3 = \left(1+\frac{R}{100}\right)^{15}$$

$$\therefore \quad \text{Time} = 15 \text{ years}$$

**60. (a)** $R = \frac{12}{2}\% = 6\%$

T = 1 × 2 = 2 half-yearly

$$\text{Interest } = 6250\left[\left(1+\frac{6}{100}\right)^2 - 1\right]$$

$$= 6250\left[\frac{(106)^2 - (100)^2}{10000}\right]$$

= 6250 × (106 + 100) (160 − 100)

$$= 6250 \times \frac{(206 \times 6)}{10000} = \frac{6250 \times 1236}{10000} = ₹772.50$$

**61.** **(d)** Let the amount be A and the rate of interest be $r$% Then,

$$A\left(1+\frac{r}{100}\right)^2 = 1460 \quad \cdots(1)$$

$$A\left(1+\frac{r}{100}\right)^3 = 1606 \quad \cdots(2)$$

On dividing eqn. (1) by eqn.. (2), we get

$$1+\frac{r}{100} = \frac{1606}{1460}$$

$$\Rightarrow \frac{r}{100} = \frac{1606}{1460} - 1 = \frac{146}{1460} = \frac{1}{10}$$

$$\therefore r = \frac{100}{10}\% = 10\%$$

**62.** **(a)** Let the amount be $A$, rate of interest be rand the required time be $t$ years.

Now, according to the question,

$$2A = A\left(1+\frac{r}{100}\right)^4$$

$$\Rightarrow 2 = \left(1+\frac{r}{100}\right)^4 \quad \cdots(1)$$

Again,

$$16A = A\left(1+\frac{r}{100}\right)^t$$

$$\Rightarrow 16 = \left(1+\frac{r}{100}\right)^t$$

$$\Rightarrow (2)^4 = \left(1+\frac{r}{100}\right)^t \quad \cdots(2)$$

Now, putting the value of 2 from Eqn. (1) in Eqn. (2), we get

$$\left(1+\frac{r}{100}\right)^{4\times 4} = \left(1+\frac{r}{100}\right)^t$$

⇒ t = (4 × 4) = 16 years

**63.** **(a)** Compound amount

$$= 4000\left(1+\frac{5}{100}\right)^2 = ₹4410$$

Simple interest $= \frac{4000 \times 5 \times 2}{100} = ₹400$

Compound interest = $A - P$

= ₹(4410 − 4000) = ₹410

∴ Difference in CI and SI

= 410 − 400 = ₹10

Quicker Method:

$$\text{Difference} = \text{Sum}\left(\frac{r}{100}\right)^2 = 4000\left(\frac{5}{100}\right)^2$$

$$= \frac{4000}{400} = ₹10$$

**64.** **(a)** Quicker Method:

For 2 years

$$\because \text{ Simple interest } = \frac{200 \times \text{Rate}}{\text{Rate (Rate} + 200)} \times \text{CI}$$

$$\Rightarrow 8400 = \frac{200r}{r(r+200)} \times 8652$$

$$\Rightarrow 8400(r^2 + 200r) = 8652 \times 200r$$

$$\Rightarrow 8400r^2 = (8652 - 8400) \times 200r$$

$$\Rightarrow 42r = 252$$

$$\therefore r = 6\%$$

**65.** **(c)** Let the sum of money invested by Raghu be ₹$P$. Then,

$$\frac{P \times 12 \times 2}{100} + \left\{P\left(1+\frac{20}{100}\right)^2 - 1\right\} = 11016$$

$$\text{or, } \frac{24P}{100} + P\left\{\left(\frac{6}{5}\right)^2 - 1\right\} = 11016$$

$$\text{or, } \frac{24P}{100} + \frac{11P}{25} = 11016$$

$$\text{or, } \frac{24P + 44P}{100} = 11016$$

or, 68P = 11016 ₹100

$$\therefore P = \frac{11016 \times 100}{68} = ₹16200$$

**66.** **(b)** $\text{SI} = \frac{p \times r \times t}{2} = \frac{7300 \times 2 \times 6}{100} = 876$

$$CI = 7300\left[\left(1\frac{6}{100}\right)^2 - 1\right] = 7300\left[\left(\frac{53}{50}\right)^2_{-1}\right]$$

$$= 7300\left[\frac{2809 - 2500}{2500}\right] = 7300 \times \frac{309}{2500} = 902.28$$

∴ Difference = 902.28 − 876 = 26.28

Quicker Method:

$$\text{CI} = \left(6 + 6 + \frac{6 \times 6}{100}\right) - (6+6)$$

$$= 12.36 - 12 = 0.36\%$$

$$= 0.36 \text{ per cent of } 7300 = 26.28$$

**68.** **(d)** Principal $= \dfrac{\text{Simple Interest} \times 100}{\text{Time} \times \text{Rate}}$

$= \dfrac{2000 \times 100}{5 \times 4} = ₹10{,}000$

$\therefore$ Compound Interest

$= \text{Principal}\left[\left(1+\dfrac{\text{Rate}}{100}\right)^{\text{Time}} - 1\right]$

$= 1000\left[\left(1+\dfrac{4}{100}\right)^{2} - 1\right]$

$= 1000\left[\left(\dfrac{26}{25}\right)^{2} - 1\right]$

$= \dfrac{10000 \times 51}{625} = ₹816$

**69.** **(a)** $\text{SI} = P\left[\left(1+\dfrac{r}{100}\right)^{t} - 1\right]$

$\Rightarrow \quad 594.5 = 5800\left[\left(1+\dfrac{r}{100}\right)^{2} - 1\right]$

$\Rightarrow \quad \dfrac{594.5}{5800} + 1 = \left(1+\dfrac{r}{100}\right)^{2}$

$\Rightarrow \quad \dfrac{6394.5}{5800} = \left(1+\dfrac{r}{100}\right)^{2}$

$\Rightarrow \quad \dfrac{r}{100} = 1.05 - 1$

$\Rightarrow \quad \dfrac{r}{100} = 0.05 \quad \Rightarrow \quad r = 5\%$

**70.** **(d)** $\text{CI} = 7400\left[\left(1+\dfrac{13.5}{100}\right)^{2} - 1\right]$

$= 7400\ [1.288225 - 1]$

$= 7400 \times 0.288225 = ₹2132.87$

**72.** **(c)** Amount $= 8000\left(1+\dfrac{15}{100}\right)^{3}$

$= 8000\left(\dfrac{20+3}{20}\right)^{3} = 8000 \times \dfrac{23}{20} \times \dfrac{23}{20} \times \dfrac{23}{20}$

$= 23 \times 23 \times 23 = 12167$

$\text{CI} = ₹12167 - 8000 = ₹4167$

# Logarithms

# 19

## INTRODUCTION

*Logarithm*, in Mathematics, is the 'exponent' or 'power' to which a stated number called the *base*, is raised to yield a specific number. For example, in the expression $10^2 = 100$, the logarithm of 100 to the **base** 10 is 2. This is written as $\log_{10} 100 = 2$. Logarithms were originally invented to help simplify the arithmetical processes of multiplication, division, expansion to a power and extraction of a 'root', but they are nowadays used for a variety of purposes in pure and applied Mathematics.

### Logarithm

If for a positive real number ($a \neq 1$), $a^m = b$, then the index $m$ is called the logarithm of $b$ to the base $a$. We write this as

$$\log_a b = m$$

'log' being the abbreviation of the word 'logarithm'. Thus,

$$a^m = b \Leftrightarrow \log_a b = m$$

where, $a^m = b$ is called the *exponential form* and $\log_a b = m$ is called the *logarithmic form*.

**Illustration 1:** Refer to the following Table

| Exponential form | logarithmic form |
|---|---|
| $3^5 = 243$ | $\log_3 243 = 5$ |
| $2^4 = 16$ | $\log_2 16 = 4$ |
| $3^o = 1$ | $\log_3 1 = 0$ |
| $8^{1/3} = 2$ | $\log_8 2 = \frac{1}{3}$ |

## LAWS OF LOGARITHMS

1. **Product formula**

   The logarithm of the product of two numbers is equal to the sum of their logarithms.
   i.e., $\log_a (mn) = \log_a m + \log_a n$.
   **Generalisation**: In general, we have
   $\log_a (mnpq...) = \log_a m + \log_a n + \log_a p + \log_a q$ +...

2. **Quotient formula**

   The logarithm of the quotient of two numbers is equal to the difference of their logarithms.
   i.e., $\log_a \left(\frac{m}{n}\right) = \log_a m - \log_a n$,
   where, $a$, $m$, $n$ are positive and $a \neq 1$.

3. **Power formula**

   The logarithm of a number raised to a power is equal to the power multiplied by logarithm of the number.
   i.e., $\log_a (m^n) = n \log_a m$,
   where, $a$, $m$ are positive and $a \neq 1$.

3. **Base changing formula**

   $\log_n m = \dfrac{\log_a m}{\log_a n}$. So, $\log_n m = \dfrac{\log m}{\log n}$.
   where, $m$, $n$, $a$ are positived and $n \neq 1$, $a \neq 1$.

4. **Reciprocal relation**

   $\log_b a \times \log_a b = 1$,
   where, $a$, $b$ are positive and not equal to 1.

5. $\log_b a = \dfrac{1}{\log_a b}$

6. $a^{\log_a x} = x$, where, $a$ and $x$ are positive, $a \neq 1$.

7. If $a > 1$ and $x > 1$, then $\log_a x > 0$.

8. If $0 < a < 1$ and $0 < x < 1$, then $\log_a x > 0$.

9. If $0 < a < 1$ and $x > 1$, then $\log_a x > 0$.

10. If $a > 1$ and $0 < x < 1$, then $\log_a x < 0$.

## SOME USEFUL SHORTCUT METHODS

1. Logarithm of 1 to any base is equal to zero.
   i.e., $\log_a 1 = 0$, where $a > 0$, $a \neq 1$.

2. Logarithm of any number to the same base is 1.
   i.e., $\log_a a = 1$, where $a > 0$, $a \neq 1$.

### Common Logarithms

There are two bases of logarithms that are extensively used these days. One is base $e$ ($e$ = 2. 71828 approx.) and the other is base 10. The logarithms to base $e$ are called natural logarithms. The logarithms to base 10 are called the common logarithms.

$\log_{10}10 = 1$, since $10^1 = 10$.
$\log_{10}100 = 2$, since $10^2 = 100$.
$\log_{10}10000 = 4$, since $10^4 = 10000$.
$\log_{10}0.01 = -2$, since $10^{-2} = 0.01$.
$\log_{10}0.001 = -3$, since $10^{-3} = 0.001$
and, $\log_{10}1 = 0$, since $10^{\circ} = 1$.

## EXERCISE-1

**1.** Find $\log_{3/2} 3.375$.
(a) 2 (b) 3
(c) 5/2 (d) 17/2

**2.** If $x = \log_{2a} a$, $y = \log_{3a} 2a$ and $z = \log_{4a} 3a$, find $yz(2 - x)$.
(a) 1 (b) −1
(c) 2 (d) −2

**3.** $\dfrac{\log x}{l+m-2m} = \dfrac{\log z}{n+l-2m} = \dfrac{\log z}{n+l-2m}$, find $x^2y^2z^2$.
(a) 2 (b) −1
(c) 4 (d) 1

**4.** If $\log \dfrac{x+y}{5} = \dfrac{1}{2}(\log x + \log y)$, then $\dfrac{x}{y} + \dfrac{y}{x} =$
(a) 20 (b) 23
(c) 22 (d) 21

**5.** If $\log(x + y) = \log\left(\dfrac{3x-3y}{2}\right)$, then $\log x - \log y =$
(a) $\log 2$ (b) $\log 3$
(c) $\log 5$ (d) $\log 6$

**6.** If $\log_2 x + \log_4 x + \log_{16} x = 21/4$, then $x =$
(a) 8 (b) 4
(c) 2 (d) 16

**7.** $7\log\dfrac{16}{15} + 5\log\dfrac{25}{24} + 3\log\dfrac{81}{80} =$
(a) $\log 2$ (b) $\log 3$
(c) $\log 5$ (d) None of these

**8.** If $0 < a \leq x$, the minimum value of $\log_a x + \log_x a$ is:
(a) 1 (b) 2
(c) 3 (d) 5

**9.** If $\dfrac{\log x}{b-c} = \dfrac{\log y}{c-a} = \dfrac{\log z}{a-b}$, then $xyz = x^a \cdot y^b \cdot z^c$
$= x^{b+c} \cdot y^{c+a} \cdot z^{a+b} =$
(a) 1 (b) 0
(c) 2 (d) None of these

**10.** $x^{\log y - \log z} \cdot y^{\log z - \log x} \cdot z^{\log x - \log y} =$
(a) 0 (b) 2
(c) 1 (d) None of these

**11.** If $\log_{10}\left[98 + \sqrt{x^2 - 12x + 36}\right] = 2$, then $x =$
(a) 4 (b) 8
(c) 12 (d) 4,8

**12.** If $x = \log_a bc$, $y = \log_b ca$, $z = \log_c ab$, then
(a) $xyz = x + y + z + 2$
(b) $xyz = x + y + z + 1$
(c) $x + y + z = 1$
(d) $xyz = 1$.

**13.** If $a^x = b^y = c^z = d^w$, then $\log_a (bcd) =$
(a) $\dfrac{1}{x}\left(\dfrac{1}{y}+\dfrac{1}{z}+\dfrac{1}{w}\right)$ (b) $x\left(\dfrac{1}{y}+\dfrac{1}{z}+\dfrac{1}{w}\right)$
(c) $\dfrac{y+z+w}{x}$ (d) None of these

**14.** If $\log_{10} 2 = 0.3010$, then $\log_{10} (1/2) =$
(a) −0.3010 (b) 0.6990
(c) $\bar{1}.6990$ (d) $\bar{1}.3010$

**15.** If $\log_2(3^{2x-2}+7) = 2 + \log_2(3^{x-1}+1)$, then $x =$

(a) 0 (b) 1
(c) 2 (d) 1 or 2

**16.** If $\log_a b = \log_b c = \log_c a$, then

(a) $a > b \geq c$ (b) $a < b < c$
(c) $a = b = c$ (b) $a < b \leq c$.

**17.** If $\dfrac{1}{\log_x 10} = \dfrac{2}{\log_a 10} - 2$, then $x =$

(a) $a/2$ (b) $a/100$
(c) $a^2/10$ (d) $a^2/100$

**18.** If $a^2 + b^2 = c^2$, then $\dfrac{1}{\log_{c+a} b} + \dfrac{1}{\log_{c-a} b} =$

(a) 1 (b) 2
(c) −1 (d) −2

**19**. If $\log_{10} 87.5 = 1.9421$, then the number of digits in $(875)^{10}$ is:

(a) 30 (b) 29
(c) 20 (d) 19

**20.** If $\log_{10} 2 = 0.3010$, $\log_{10} 3 = 0.4771$, then the number of zeros between the decimal point and the first significant figure in $(0.0432)^{10}$ is:

(a) 10 (b) 13
(c) 14 (d) 15

**21.** If $(4.2)^x = (0.42)^y = 100$, then $\dfrac{1}{x} - \dfrac{1}{y} =$

(a) 1 (b) 2
(c) 1/2 (d) −1

**22.** $\dfrac{\log_9 11}{\log_5 13} - \dfrac{\log_3 11}{\log_{\sqrt{5}} 13} =$

(a) 1 (b) −1
(c) 0 (d) None of these

**23.** If $\dfrac{\log x}{2} = \dfrac{\log y}{3} = \dfrac{\log z}{5}$, then $yz$ in terms of $x$ is:

(a) $x$ (b) $x^2$
(c) $x^3$ (d) $x^4$

**24.** If $4^x + 2^{2x-1} = 3^{x+\frac{1}{2}} + 3^{x-\frac{1}{2}}$, then $x =$

(a) 1/2 (b) 3/2
(c) 5/2 (d) 1

**25.** $\dfrac{\log 49\sqrt{7} + \log 25\sqrt{5} - \log 4\sqrt{2}}{\log 17.5} =$

(a) 5 (b) 2
(c) 5/2 (d) 3/2

**26.** $\log_{10} \tan 40° \cdot \log_{10} 41° \ldots \log_{10} \tan 50° =$

(a) 1 (b) 0
(c) −1 (d) None of these

**27.** If $\log_8 p = 2.5$, $\log_2 q = 5$, then $p$ in terms of $q$ is

(a) $q\sqrt{q}$ (b) $2q$
(c) $q$ (d) $q/2$

**28.** If $y = \dfrac{1}{a^{1-\log_a x}}$, $z = \dfrac{1}{a^{1-\log_a y}}$ and $x = a^k$, then $k =$

(a) $\dfrac{1}{a^{1-\log_a z}}$ (b) $\dfrac{1}{1-\log_a z}$

(c) $\dfrac{1}{1+\log_z a}$ (d) $\dfrac{1}{1-\log_z a}$

**29.** If $\log_e 2 \cdot \log_b 625 = \log_{10}{}^{16} \cdot \log_e 10$, then $b =$

(a) 4 (b) 5
(c) 1 (d) $e$

**30.** $5^{\sqrt{\log_5 7}} - 7^{\sqrt{\log_7 5}}$

(a) $\log 2$ (b) 1
(c) 0 (d) None of these

**31.** $2^{\log_3 7} - 7^{\log_3 2}$

(a) $\log_2 7$ (b) $\log 7$
(c) $\log 2$ (d) 0

**32.** If $\log_{30} 3 = a$, $\log_{30} 5 = b$, then $\log_{30} 8 =$

(a) $3(1 - a - b)$ (b) $a - b + 1$
(c) $1 - a - b$ (d) $3(a - b + 1)$

**33.** If $0 < a < 1$, $0 < x < 1$ and $x < a$, then $\log_a x$:

(a) $< 1$ (b) $> 1$
(c) $< 0$ (d) $\leq 1$

**34.** $\log_5 2$ is

(a) an integer (b) a rational number
(c) an irrational number (d) a prime number

**35.** $\log_5\left(1+\dfrac{1}{5}\right) + \log_5\left(1+\dfrac{1}{6}\right) + \log_5\left(1+\dfrac{1}{7}\right) + \cdots + \log_5\left(1+\dfrac{1}{624}\right)$

(a) 5 (b) 4
(c) 3 (d) 2

**36.** If $\log_{10} 2986 = 3.4751$, then $\log_{10} 0.02986 =$

(a) $\bar{1}.2986$ (b) $\bar{2}.4751$
(c) 0.34751 (d) None of these

**37.** If $\log(2a - 3b) = \log a - \log b$, then $a =$

(a) $\dfrac{3b^2}{2b-1}$ (b) $\dfrac{3b}{2b-1}$

(c) $\dfrac{b^2}{2b+1}$ (d) $\dfrac{3b^2}{2b+1}$

**38.** If $\log(x - y) - \log 5 - \frac{1}{2}\log x - \frac{1}{2}\log y = 0$, then $\frac{x}{y} + \frac{y}{x} =$

(a) 25 (b) 26
(c) 27 (d) 28

**39.** If $\log x{:}3 = \log y{:}4 = \log z{:}5$, then $zx =$

(a) $2y$ (b) $y^2$
(c) $8y$ (d) $4y$

**40.** If $3 + \log_5 x = 2\log_{25} y$, then $x =$

(a) $y/125$ (b) $y/25$
(c) $y^2/625$ (d) $3 - y^2/25$

**41.** If $\frac{\log_2 a}{3} = \frac{\log_3 b}{3} = \frac{\log_4 c}{4}$ and $a^{1/2} \cdot b^{1/3} \cdot c^{1/4} = 24$, then

(a) $a = 24$ (b) $b = 81$
(c) $c = 64$ (d) $c = 256$

**42.** If $\frac{\log_2 x}{3} = \frac{\log_2 y}{4} = \frac{\log_2 z}{5k}$ and $\frac{z}{x^3 y^4} = 1$, then $k =$

(a) 3 (b) 4
(c) 5 (d) –5

**43.** $\dfrac{3 + \log_{10} 343}{2 + \frac{1}{2}\log\left(\frac{49}{4}\right) + \frac{1}{3}\log\left(\frac{1}{125}\right)} =$

(a) 3 (b) 3/2
(c) 2 (d) 1

**44.** If $\frac{\log x}{a^2 + ab + b^2} = \frac{\log y}{b^2 + bc + c^2} = \frac{\log z}{c^2 + ca + a^2}$, then $x^{a-b} \cdot y^{b-c} \cdot z^{c-a} =$

(a) 0 (b) –1
(c) 1 (d) 2

**45.** If $3^{x-2} = 5$ and $\log_{10} 2 = 0.20103$, $\log_{10} 3 = 0.4771$, then $x =$

(a) $1\frac{22187}{47710}$ (b) $2\frac{22187}{47710}$
(c) $3\frac{22187}{47710}$ (d) None of these

**46.** If $\log_2 = 0.30103$ and $\log_3 = 0.4771$, then number of digits in $(648)^5$ is:

(a) 12 (b) 13
(c) 14 (d) 15

**47.** If $\log x = \frac{\log y}{2} = \frac{\log z}{5}$, then $x^4 \cdot y^3 \cdot z^{-2} =$

(a) 2 (b) 10
(c) 1 (d) 0

**48.** $\dfrac{\log\sqrt{27} + \log\sqrt{1000} + \log 8}{\log 120}$

(a) 1/2 (b) 1
(c) 3/2 (d) 2

**49.** For $x > 0$, if $y = \dfrac{10^{\log_{10}^{x}}}{x^2}$ and $x = y^a$, then $a =$

(a) 1 (b) –1
(c) 0 (d) 2

**50.** If $x = 100_{4/3}(1/2)$, $y = \log_{1/2}(1/3)$, then

(a) $x > y$ (b) $x < y$
(c) $x = y$ (d) $x \geq y$

## Exercise-2
## (Based on Memory)

**1.** If $\log 2 = 0.30103$, the number of digits in $2^{64}$ is:

(a) 18 (b) 19
(c) 20 (d) 21

**[SI of Police Rec. Examination, 1997]**

**2.** If $\log_{10} 2 = 0.301$, then the value of $\log_{10}(50)$ is

(a) 0.699 (b) 1.301
(c) 1.699 (d) 2.301

**[SI Rec. (Delhi Police) Examination, 1997]**

**3.** Given that $\log_{10} 2 = 0.3010$, the $\log_2 10$ is equal to:

(a) 0.3010 (b) 0.6990
(c) $\frac{1000}{301}$ (d) $\frac{699}{301}$

**[Assistant's Grade Examination, 1997]**

**4.** If $\log 2 = x$, $\log 3 = y$ and $\log 7 = z$, then the value of $\log(4.\sqrt[3]{63})$ is:

(a) $-2x + \frac{2}{3}y + \frac{1}{3}z$ (b) $2x + \frac{2}{3}y + \frac{1}{3}z$
(c) $2x + \frac{2}{3}y - \frac{1}{3}z$ (d) $2x - \frac{2}{3}y + \frac{1}{3}z$

**[Assistant's Grade Examination, 1998]**

**5.** If $\log_{12} 27 = a$, then $\log_6 16$ is:

(a) $\frac{4(3-a)}{3+a}$ (b) $\frac{4(3+a)}{3-a}$

(c) $\frac{3+a}{4(3-a)}$ (d) $\frac{3-a}{4(3+a)}$

**[Assistant's Grade Examination, 1998]**

**6.** If $\log_x 4 = 0.4$, then the value of $x$ is:

(a) 4 (b) 16

(c) 1 (d) 32

**[Assistant's Grade Examination, 1998]**

**7.** If $\log_x y = 100$ and $\log_2 x = 10$, then the value of $y$ is:

(a) $2^{10}$ (b) $2^{1000}$

(c) $2^{100}$ (d) $2^{10000}$

**[SSC (GL) Prel. Examination, 1999]**

**8.** If $\log_{10} 2 = 0.3010$ and $\log_{10} 7 = 0.8451$, then the value of $\log_{10} 2.8$ is:

(a) 0.4471 (b) 1.4471

(c) 2.4471 (d) 1.4471

**[SSC (GL) Prel. Examination, 1999]**

**9.** If $\log(0.57) = \bar{1}.756$, then the value of $\log 57 + \log(0.57)^3 + \log\sqrt{0.57}$ is:

(a) 0.902 (b) $\bar{1}.902$

(c) 1.146 (d) 2.146

**[SSC (GL) Prel. Examination, 1999]**

**10.** If $\log_{10} 2 = 0.3010$ is given, then $\log_2 10$ is equal to:

(a) 0.3010 (b) 0.6990

(c) $\frac{1000}{301}$ (d) $\frac{699}{301}$

**[SSC (GL) Prel. Examination, 2000]**

**11.** If $\log 3 = 0.477$ and $(1000)^x = 3$, then $x$ equals.

(a) 0.159 (b) 10

(c) 0.0477 (d) 0.0159.

**[SSC (GL) Prel. Examination, 2000]**

**12.** If $\log 2 = 0.3010$, then $\log 5$ equals.

(a) 0.3010

(b) 0.699

(c) 0.7525

(d) Given $\log_2$, it is not possible to calculate $\log_5$.

**[SSC (GL) Prel. Examination, 2000]**

**13.** If $\log 90 = 1.9542$ then $\log 3$ equals.

(a) 0.9771 (b) 0.6514

(c) 0.4771 (d) 0.3181

**[SSC (GL) Prel. Examination, 2000]**

**14.** The number of digits in $8^{10}$ is (when $\log_2 = 0.30103$)

(a) 19 (b) 10

(c) 17 (d) 16

**[RRB, Kolkata Supervisor (P.Way) Examination, 2000]**

**15.** If $\log_{10}(x^2 - 6x + 45) = 2$, then the values of $x$ are:

(a) 10, 5 (b) 11, −5

(c) 6, 9 (d) 9, −5

**[RRB Allahabad ASM Examination, 2002]**

**16.** If $\log_{10} 2 = 0.30$, then $\log_2 10$ is:

(a) 3.3220 (b) 5

(c) 0.3322 (d) 3.2320

**[RRB Allahabd ASM Examination, 2002]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (a) | **3.** (d) | **4.** (b) | **5.** (c) | **6.** (a) | **7.** (a) | **8.** (b) | **9.** (a) | **10.** (c) | **11.** (d) | **12.** (a) | **13.** (b) |
| **14.** (c) | **15.** (d) | **16.** (c) | **17.** (d) | **18.** (b) | **19.** (a) | **20.** (b) | **21.** (c) | **22.** (c) | **23.** (d) | **24.** (b) | **25.** (c) | **26.** (b) |
| **27.** (a) | **28.** (b) | **29.** (b) | **30.** (c) | **31.** (d) | **32.** (a) | **33.** (b) | **34.** (c) | **35.** (b) | **36.** (b) | **37.** (a) | **38.** (c) | **39.** (b) |
| **40.** (a) | **41.** (d) | **42.** (c) | **43.** (a) | **44.** (c) | **45.** (c) | **46.** (d) | **47.** (c) | **48.** (c) | **49.** (b) | **50.** (b) | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (c) | **3.** (c) | **4.** (b) | **5.** (a) | **6.** (d) | **7.** (b) | **8.** (a) | **9.** (a) | **10.** (c) | **11.** (a) | **12.** (b) | **13.** (c) |
| **14.** (b) | **15.** (b) | **16.** (a) | | | | | | | | | | |

# EXPLANATORY ANSWERS

## Exercise-1

1. **(b)** $\log_{3/2} 3.375 = x \Rightarrow \left(\frac{3}{2}\right)^x = 3.375$

$\Rightarrow (1.5)^x = (1.5)^3 \Rightarrow x = 3.$

2. **(a)** $yz(2 - x) = 2yz - xyz = 2\log_{4a} 2a - \log_{4a} a$

$= \log_{4a}\left(\frac{4a^2}{a}\right) = 1.$

3. **(d)** Each is equal to $k$

$\Rightarrow \log x = k\ (l + m - 2n),$

$\log y = k\ (m + n - 2l)$, $\log z = k\ (n + l - 2m).$

$\Rightarrow \log xyz = k\ (0) \Rightarrow xyz = e^0 = 1 \Rightarrow x^2y^2z^2 = 1.$

4. **(b)** $\log\left(\frac{x+y}{5}\right) = \frac{1}{2}[\log x + \log y]$

$\Rightarrow x + y = 5\sqrt{xy} \Rightarrow x^2 + y^2 = 23xy$

$\Rightarrow \frac{x}{y} + \frac{y}{x} = 23.$

5. **(c)** $x + y = \frac{3x - 3y}{2} \Rightarrow x = 5y \Rightarrow \frac{x}{y} = 5$

$\Rightarrow \log x - \log y = \log 5.$

6. **(a)** $\log_2 x + \frac{1}{2}\log_2 x + \frac{1}{4}\log_2 x = \frac{21}{4}$

$\Rightarrow \log_2{}^x\left(1 + \frac{1}{2} + \frac{1}{4}\right) = \frac{21}{4} \Rightarrow \log_2 x = 3 \Rightarrow x = 8.$

7. **(a)** $7\log\left(\frac{2^4}{5\times 3}\right) + 5\log\left(\frac{5^2}{2^3\times 3}\right) + 3\log\left(\frac{3^4}{2^4\times 5}\right)$

$= 28\log 2 - 7\log 5 - 7\log 3 + 10\log 5 - 15\log 2$

$-5\log 3 + 12\log 3 - 12\log 2 - 3\log 5 = \log 2.$

8. **(b)** $0 < a \le x$; Min. value of $\log_a x + \log_x a$ is 2 when we put $x = a$.

9. **(a)** $\frac{\log x}{b-c} = \frac{\log y}{c-a} = \frac{\log z}{a-b} = k$ (say)

$\Rightarrow \log x = k\ (b - c)$, $\log y = k\ (c - a)$, $\log z = k\ (a - b)$

$\Rightarrow \log x + \log y + \log z = 0 \Rightarrow xy\ z = 1.$

Also, $a\log x + b\log y + c\log z = 0 \Rightarrow x^a \cdot y^b \cdot z^c = 1.$

Again $(b + c)\log x + (c + a)\log y + (a + b)\log z = 0.$

$\Rightarrow x^{b+c} \cdot y^{c+a} \cdot z^{a+b} = 1.$

$\therefore\ xyz = x^a \cdot y^b \cdot z^c = x^{b+c} \cdot y^{c+a} \cdot z^{a+b} = 1.$

10. **(c)** $x^{\log y - \log z} \cdot y^{\log z - \log x} \cdot z^{\log x - \log y} = k$ (say)

$\Rightarrow (\log y - \log z)\log x + (\log z - \log x)\log y$

$+ (\log x - \log y)\log z = \log k = 0$

$\Rightarrow k = 1.$

11. **(d)** $98 + \sqrt{x^2 - 12x + 36} = 100$

$\Rightarrow \sqrt{x^2 - 12x + 36} = 2$

$\Rightarrow x^2 - 12x + 32 = 0$

$\Rightarrow x = 8, 4.$

12. **(a)** $x = \log_a bc \Rightarrow a^x = bc \Rightarrow a^{x+1} = abc$

$\Rightarrow a = (abc)^{1/x+1}.$

Similarly, $b = (abc)^{1/y+1}$ and $c = (abc)^{1/z+1}$

$\therefore\ abc = (abc)^{\frac{1}{x+1}+\frac{1}{y+1}+\frac{1}{z+1}}$

$\Rightarrow 1 = \frac{1}{x+1} + \frac{1}{y+1} + \frac{1}{z+1}$

$\Rightarrow (x + 1)(y + 1)(z + 1) = (y + 1)(z + 1)$

$+ (x + 1)(z + 1) + (x + 1)(y + 1)$

$\Rightarrow xyz = x + y + z + 2.$

13. **(b)** $b^y = a^x \Rightarrow b = a^{\frac{x}{y}}, c = a^{\frac{x}{z}}, d = a^{\frac{x}{w}}$

$\log_a(bcd) = \log_a\left(a^{\frac{x}{y}}.a^{\frac{x}{z}}.a^{\frac{x}{w}}\right) = \frac{x}{y} + \frac{x}{z} + \frac{x}{w} = x\left(\frac{1}{y} + \frac{1}{z} + \frac{1}{w}\right).$

14. **(c)** $\log_{10}\left(\frac{1}{2}\right) = -\log_{10} 2 = -0.3010$

$= 1 - 0.3010 - 1 = \bar{1}.6990.$

15. **(d)** $\log_2(3^{2x-2} + 7) = \log_2{}^4 + \log_2(3^{x-1} + 1)$

$[\because\ 2 = 2\log_2{}^2 = \log_2 2^2]$

$\Rightarrow 3^{2x-2} + 7 = 4\ (3^{x-1} + 1)$

$\Rightarrow t^2 + 7 = 4(t + 1)$, where, $3^{x-1} = t$

$\Rightarrow t^2 - 4t + 3 = 0 \Rightarrow t = 1, 3$

When $t = 1 \Rightarrow 3^{x-1} = 1 \Rightarrow x = 1$

When $t = 3 \Rightarrow 3^{x-1} = 3^1 \Rightarrow x = 2.$

16. **(c)** $\log_a b = \log_b c = \log_c a = k$ (say)

$b = a^k$, $c = b^k$, $a = c^k$

$\Rightarrow c = (a^k)^k = a^{k2} = (c^{k2})^k = c^{k3}$

$\Rightarrow k^3 = 1 \Rightarrow k = 1.\ \therefore\ a = b = c.$

17. **(d)** $\log_{10} x = 2\log_{10} a - 2$

$\Rightarrow \log_{10} x = 2\ (\log_{10} a - 1)$

$\Rightarrow \log_{10} x = 2\log_{10}\left(\frac{a}{10}\right) \Rightarrow x = \frac{a^2}{100}.$

18. **(b)** $\log_b(c + a) + \log_b(c - a)$

$= \log_b(c^2 - a^2) = \log_b b^2 = 2.$

**19. (a)** $x = (875)^{10} = (87.5 \times 10)^{10}$

$\therefore \quad \log_{10} x = 10(\log_{10} 87.5 + 1)$

$= 10(1.9421 + 1)$

$= 10(2.9421) = 29.421.$

$\therefore \quad x = \text{Antilog } (29.421).$

$\therefore$ Number of digits in $x = 30$.

**20. (b)** $x = (0.0432)^{10} = \left(\dfrac{432}{10000}\right)^{10} = \left(\dfrac{3^3.2^4}{10^4}\right)^{10}$

$\therefore \quad \log_{10} x = 10\ (3\log_{10}3 + 4\log_{10}2 - 4)$

$= 10\ (1.4313 + 1.2040 - 4)$

$= 10\ (-1.3647) = -13.647$

$= \bar{1}4.353$

$\therefore \quad x = \text{Antilog } (\bar{1}4.353)$

$\therefore$ Number of zeros between the decimal and the first significant figure = 13.

**21. (c)** $(4.2)^x = 100 \quad \Rightarrow \quad (42)^x = 10^{2+x}$

$\Rightarrow \quad 42 = \left(\dfrac{42}{100}\right)^y \qquad \cdots(1)$

$\dfrac{2}{x} - \dfrac{2}{y} = 100 \quad \Rightarrow \quad (42)^y = 10^{2+2y}$

$\Rightarrow \quad 42 = 10^{\frac{2}{y}+2} \qquad \cdots(2)$

From (1) and (2), $\dfrac{2}{x} - \dfrac{2}{y} = 1 \Rightarrow \dfrac{1}{x} - \dfrac{1}{y} = \dfrac{1}{2}$.

**22. (c)** $\dfrac{\log_9 11}{\log_5 13} - \dfrac{\log_3 11}{\log_{\sqrt{5}} 13} = \dfrac{\log_3 11}{2.\log_5 13} - \dfrac{\log_3 11}{2.\log_5 13} = 0.$

**23. (d)** $\dfrac{\log x}{2} = \dfrac{\log y}{3} = \dfrac{\log z}{5} = k$ (say)

$\Rightarrow \quad \log x = 2k,\ \log y = 3k,\ \log z = 5k$

$\Rightarrow \quad \log yz = 3k + 5k = 8k;\ \log x^4 = 8k$

$\therefore \quad \log yz = \log x^4 \quad \Rightarrow \quad yz = x^4.$

**24. (b)** $4^x + \dfrac{4^x}{2} = \dfrac{3^x}{\sqrt{3}} + 3^x.\sqrt{3}$

$\Rightarrow \quad 4^x \cdot \dfrac{3}{2} = 3^x \cdot \dfrac{4}{\sqrt{3}} \Rightarrow \left(\dfrac{4}{3}\right)^x = \dfrac{8}{3\sqrt{3}}$

$\Rightarrow \quad \left(\dfrac{4}{3}\right)^x = \left(\dfrac{4}{3}\right)^{3/2} \Rightarrow x = \dfrac{3}{2}.$

**25. (c)** $\dfrac{\log 7^{5/2} + \log 5^{5/2} - \log 2^{5/2}}{\log 17.5}$

$= \dfrac{5(\log 7 + \log 5 - \log 2)}{2\log\left(\dfrac{35}{2}\right)} = \dfrac{5}{2}$

**26. (b)** $\log_{10} \tan 40° \cdot \log_{10} \tan 41° \cdots \log_{10} \tan 50°$

$= 0$, since $\log_{10} \tan 45 = 0$.

**27. (a)** $\log_8 p = \dfrac{5}{2} \quad \Rightarrow \quad p = (8)^{5/2} = 2^{\frac{15}{2}} = (2^5)^{3/2}$

$\log_2 q = 5 \quad \Rightarrow \quad q = 2^5.$

$\therefore \quad p = q^{3/2}.$

**28. (b)** $\log_a y = \dfrac{1}{1 - \log_a x}$, $\log_a z = \dfrac{1}{1 - \log_a y}$

$\therefore \quad \log_a z = \dfrac{1}{1 - \left(\dfrac{1}{1 - \log_a x}\right)} = \dfrac{1 - \log_a x}{-\log_a x}$

$\Rightarrow \quad -\log_a z = -1 + \dfrac{1}{\log_a x}$

$\Rightarrow \quad \dfrac{1}{\log_a x} = 1 - \log_a z$

$\therefore \quad \log_a x = \dfrac{1}{1 - \log_a z} \Rightarrow x = \dfrac{1}{a^{1-\log_a^z}} = a^k$ (given)

$\therefore \quad k = \dfrac{1}{1 - \log_a z}.$

**29. (b)** $\log_e 2 \cdot 4\log_b 5 = 4 \cdot \log_{10} 2 \cdot \log_e 10 = 4\log_e 2$

$\Rightarrow \quad \log_b 5 = 1 \quad \Rightarrow \quad b = 5.$

**30. (c)** $5^{\sqrt{\log_5 7}} - (7^{\log_7 5})^{\frac{1}{\sqrt{\log_7 5}}}$

$= 5^{\sqrt{\log_5 7}} - \dfrac{1}{5^{\sqrt{\log_7 5}}}$

$\Rightarrow \quad 5^{\sqrt{\log_5 7}} - 5^{\sqrt{\log_5 7}} = 0.$

**31. (d)** $2^{\log 37} - 7^{\log 32} = 2^{\log 27\ .\ \log 32} - 7^{\log 32}$

$= 7^{\log 32} - 7^{\log 32} = 0.$

**32. (a)** $a + b = \log_{30} 15 = \log_{30}\left(\dfrac{30}{2}\right) = 1 - \log_{30} 2$

$\Rightarrow \quad \log_{30} 2 = 1 - a - b.$

$\therefore \quad \log_{30} 8 = 3(1 - a - b).$

**33. (b)** $0 < a < 1,\ 0 < x < 1$ and $x < a$

$\Rightarrow \quad \log_a x > \log_a a \quad \Rightarrow \quad \log_a x > 1.$

**34. (c)** $\log_5 2 = \dfrac{p}{q} \quad \Rightarrow \quad 2 = 5^{p/q} = 2^q = 5^p$

$\Rightarrow$ even number = odd number, which is a contradiction.

$\therefore \quad \log_5 2$ is an irrational number.

**35. (b)** $\log_5 \dfrac{6}{5} + \log_5 \dfrac{7}{6} + \log_5 \dfrac{8}{7} + \cdots + \log_5 \dfrac{625}{624}$

$= \log_5\left(\dfrac{6}{5} \cdot \dfrac{7}{6} \cdot \dfrac{8}{7} \cdots \dfrac{625}{624}\right) = \log_5\left(\dfrac{625}{5}\right) = 4.$

**36.** **(b)** $\log_{10}(0.02986) = \log_{10}\left(\dfrac{2986}{100000}\right)$

$= 3.4751 - 5 = -1.5249$

$= \bar{2}.4751.$

**37.** **(a)** $2a - 3b = \dfrac{a}{b} \Rightarrow 2ab - 3b^2 = a$

$\Rightarrow 3b^2 = a(2b - 1)$

$\Rightarrow a = \dfrac{3b^2}{2b-1}.$

**38.** **(c)** $(x - y)^2 = 25xy \Rightarrow x^2 + y^2 = 27xy \Rightarrow \dfrac{x}{y}+\dfrac{y}{x} = 27.$

**39.** **(b)** $\dfrac{\log x}{3}=\dfrac{\log y}{4}=\dfrac{\log z}{5} = k$

$\Rightarrow \log x = 3k;\ \log y = 4k;\ \log z = 5k.$

$\Rightarrow \log(zx) = \log z + \log x = 8k = 2\log y$

$\therefore zx = y^2.$

**40.** **(a)** $3 + \log_5 x = \log_5 y \Rightarrow \log_5(125x) = \log_5 y \Rightarrow x = \dfrac{y}{125}.$

**41.** **(d)** $\dfrac{\log_2 a}{3}=\dfrac{\log_3 b}{3}=\dfrac{\log_4 c}{4}=k$

$\Rightarrow a = 2^{2k},\ b = 3^{3k},\ c = 4^{4k}$ and

$a^{1/2} \cdot b^{1/3} \cdot c^{1/4} = 2^k \cdot 3^k \cdot 4^k = 24$

$\Rightarrow 24^k = 24^1 \Rightarrow k = 1.$

$\therefore a = 4,\ b = 27,\ c = 256.$

**42.** **(c)** $\dfrac{z}{x^3y^4} = 1 \Rightarrow \log_2 z - 3\log_2 x - 4\log_2 y = 0$

$\Rightarrow \log_2 z - \dfrac{3.3}{5k}\cdot\log_2 z - 4\cdot\dfrac{4}{5k}\cdot\log_2 z = 0$

$\Rightarrow 1 - \dfrac{9}{5k}-\dfrac{16}{5k} = 0$

$\Rightarrow 5k - 25 = 0 \Rightarrow k = 5.$

**43.** **(a)** $\dfrac{3(1+\log_{10}7)}{2+\log\dfrac{7}{2}+\log\dfrac{1}{5}}=\dfrac{3(1+\log_{10}7)}{2+\log\left(\dfrac{7}{10}\right)}$

$= \dfrac{3(1+\log_{10}7)}{1+\log_{10}7} = 3.$

**44.** **(c)** Each ratio $= k \Rightarrow \log x = k(a^2 + ab + b^2)$

$\Rightarrow (a - b)\log x = k(a^3 - b^3)$

$\Rightarrow \log x^{a-b} = k(a^3 - b^3) \Rightarrow x^{a-b} = e^{k(a^3-b^3)}$

Similarly, $y^{b-c} = e^{k(b^3-c^3)}$, $z^{c-a} = e^{k(c^3-a^3)}$.

$\therefore x^{a-b} . y^{b-c} . z^{c-a} = e^0 = 1.$

**45.** **(c)** $3^{x-2} = 5 \Rightarrow 3^x = 45 = \left(\dfrac{90}{2}\right)$

$\Rightarrow x\log_{10}3 = \log_{10}90 - \log_{10}2$

$= 2\log_{10}3 + 1 - \log_{10}2$

$\Rightarrow x(0.4771) = 1.65317$

$\Rightarrow x = \dfrac{165317}{47710}=3\dfrac{22187}{47710}.$

**46.** **(d)** $\log(648)^5 = 5\log(81 \times 8) = 20\log 3 + 15\log 2$

$= 20(0.4771) + 15(0.30103)$

$= 14.05745.$

$\therefore$ Number of digits in $(648)^5$ is 15.

**47.** **(c)** $\dfrac{\log x}{1}=\dfrac{\log y}{2}=\dfrac{\log z}{5}=k$

$\Rightarrow \log x = k,\ \log y = 2k,\ \log z = 5k.$

$\therefore \log(x^4 . y^3 . z^{-2}) = 4\log x + 3\log y - 2\log z = 0$

$\Rightarrow x^4 . y^3 . z^{-2} = 1.$

**48.** **(c)** $\dfrac{\log\sqrt{27}+\log\sqrt{1000}+\log 8}{\log 120}$

$= \dfrac{\dfrac{3}{2}(\log 3+\log 10+\log 4)}{\log 3+\log 10+\log 4}=\dfrac{3}{2}$

**49.** **(b)** $y = \dfrac{10^{\log_{10}x}}{x^2}=\dfrac{1}{x}=\dfrac{1}{y^a} = y^{-a} \Rightarrow a = -1.$

**50.** **(b)** $x = \log_{4/w3}(1/2) = -\log_{4/3} 2 < 0$

and, $y = \log_{1/2}(1/3) = \log_2 3 > 0 \Rightarrow y > x.$

## EXERCISE-2
## (BASED ON MEMORY)

1. **(c)** $\log 2^{64} = 64\log 2 = 64 \times .30103 = 19.26592.$

$\therefore$ Number of digits in $2^{64} = 19 + 1 = 20.$

2. **(c)** $\log_{10} 50 = \log_{10}\left(\dfrac{50\times 2}{2}\right) = \log_{10}\dfrac{100}{2}$

$= \log_{10} 100 - \log_{10} 2 = 2 - .301 = 1.699.$

3. **(c)** $\log_2 10 = \dfrac{\log 10}{\log 2} = \dfrac{1}{\log 2} = \dfrac{1.0000}{.3010}$

$= \dfrac{10000}{3010} = \dfrac{1000}{301}$

4. **(b)** $\log(4 \times \sqrt[3]{63}) = \log(2^2 \times (3 \times 3 \times 7)^{1/3})$

$= \log 2^2 + \log(3 \times 3 \times 7)^{1/3}$

$= 2\log 2 + \dfrac{1}{3}\log(3^2 \times 7)$

$= 2\log 2 + \dfrac{1}{3}(\log 3^2 + \log 7)$

$= 2\log 2 + \dfrac{2}{3}\log 3 + \dfrac{1}{3}\log 7$

$= 2x + \dfrac{2}{3}y + \dfrac{1}{3}z.$

5. **(a)** $\log_{12} 27 = a \Rightarrow \dfrac{\log 27}{\log 12} = a$

$\Rightarrow a\log 12 = \log 3^3$

$\Rightarrow a\log(4 \times 3) = 3\log 3$

$\Rightarrow a(\log 4 + \log 3) = 3\log 3$

$\Rightarrow a\log 4 + a\log 3 = 3\log 3$

$\Rightarrow a\log 2^2 = (3 - a)\log 3$

$\Rightarrow 2a\log 2 = (3 - a)\log 3$

$\Rightarrow \dfrac{\log 2}{\log 3} = \dfrac{3-a}{2a}.$

Now, $\log_6 16 = \dfrac{\log 16}{\log 6} = \dfrac{\log 2^4}{\log(2\times 3)}$

$= \dfrac{4\log 2}{\log 2 + \log 3} = \dfrac{4\dfrac{\log 2}{\log 3}}{\dfrac{\log 2}{\log 3}+1}a$

$= \dfrac{4\left(\dfrac{3-a}{2a}\right)}{\dfrac{3-a}{2a}+1} = \dfrac{4(3-a)}{3+a}.$

6. **(d)** $\dfrac{\log 4}{\log x} = \dfrac{2}{5} \Rightarrow \dfrac{2\log 2}{\log x} = \dfrac{2}{5}$

$\Rightarrow \log x = 5\log 2 = \log 2^5 = \log 32$

$\Rightarrow x = 32.$

7. **(b)** $\log_x^y = 100,\ \log_2^x = 10$

$\Rightarrow \dfrac{\log y}{\log x} = 100,\ \dfrac{\log x}{\log 2} = 10$

$\Rightarrow \dfrac{\log y}{\log 2} = 1000 \Rightarrow \log_2 y = 1000$

$\Rightarrow y = 2^{1000}.$

8. **(a)** $\log_{10} 2.8 = \log_{10}\dfrac{28}{10} = \log 28 - \log 10$

$= \log(7 \times 4) - \log 10$

$= \log 7 + 2\log 2 - \log 10$

$= 0.8451 + 2 \times 0.3010 - 1$

$= 0.8451 + 0.6020 - 1 = 0.4471.$

9. **(a)** $\log\left(\dfrac{57\times 100}{100}\right) + 3\log(0.57) + \dfrac{1}{2}\log(0.57)$

$= \log(0.57) + \log 10^2 + 3\log(0.57) + \dfrac{1}{2}\log(0.57)$

$= \left(1+3+\dfrac{1}{2}\right)\log(0.57) + 2 = (4.5\times\bar{1}.756)+2$

$= 4.5 \times (-1 + .756) + 2 = 0.902.$

10. **(c)** $\log_2 10 = \dfrac{\log 10}{\log 2} = \dfrac{1}{.3010} = \dfrac{1000}{301}a.$

11. **(a)** $x\log 1000 = \log 3 \Rightarrow 3x = \log 3$

$\Rightarrow x = \dfrac{\log 3}{3} = \dfrac{.477}{3} = .159.$

12. **(b)** $\log 5 = \log\dfrac{10}{2} = \log 10 - \log 2$

$= 1 - 0.3010 = 0.6990.$

13. **(c)** $\log 90 = 1.9542$

$\Rightarrow \log(3^2 \times 10) = 1.9542$

$\Rightarrow 2\log 3 + \log 10 = 1.9542$

$\Rightarrow \log 3 = \dfrac{.9542}{2} = .4771.$

14. **(b)** $8^{10} = (2^3)^{10} = 2^{30}.$

Let, $y = 2^{30} \Rightarrow \log y = \log(2)^{30} = 30\log 2$

$= 30 \times 0.30103 = 9.0309$

$\therefore\ y = (10)^{9.0309}$, which contains 10 digits.

15. **(b)** $\log_{10}(x^2 - 6x + 45) = 2$

$\Rightarrow x^2 - 6x + 45 = 10^2$

$\Rightarrow x^2 - 6x + 45 - 100 = 0$

$\Rightarrow x^2 - 6x - 55 = 0$

$\Rightarrow (x + 5)(x - 11) = 0$

$\Rightarrow x = 11$ or $-5.$

16. **(a)** $\log_{10}2 = 0.3010$

$\therefore\ \log_2 10 = \dfrac{1}{\log_{10} 2} = \dfrac{1}{0.3010} = 3.3220$

# Stocks, Shares and Debentures 20

## INTRODUCTION

To start a big business or an industry, a large sum of money is required. It may not be possible for one or two persons to arrange for the requisite finance and expertise required for the project. So, a number of individuals join hands to form a company called a 'Joint Stock Company'. It is a registered body under the Companies Act. The persons who join together to form the company are called its 'Promoters'. The total amount of money required by the company is called the 'Capital'.

The promoters of the company issue a circular giving the details of the project, its benefits and drawbacks and invite the public to come forward and subscribe towards the capital of the company. The company divides the required capital into small units of equal amount. Each unit is called a 'share'. Each person, who purchases one or more shares of the company is called a 'shareholder' of the company. The company issues a 'share certificate' to each of its shareholders stating the number of shares alloted to the person and the value of each share. The value of a share, as stated on the share certificate is called the 'nominal value' (or **'face value'**, or **'par value'**) of the share.

When a company earns a profit during a financial year, a part of it is used in paying for working expenses, taxes, interest on loans and keeping some part of it as reserve fund for future expansion of the project, the remaining profit is distributed among the shareholders. The distributed profit is called the 'dividend'.

Dividends are declared annually, semi-annually, quarterly as per regulations of the company. The dividend on a share is expressed as certain percentage of its face value which is printed on the share certificate. Sometimes it is also expressed as a specified amount per share. For example, we may say that dividend on a share is 12% of its face value or the dividend is ₹2 per share.

**Illustration 1:** Find the annual dividend paid in each of the following cases:

| Sl. No. | Par value of a share | Number of Common Shares | Rate of dividend declared on a Common Share |
|---|---|---|---|
| (1) | ₹10 | 500 | 10% per annum |
| (2) | ₹10 | 800 | 5% semi-annually |
| (3) | ₹100 | 1500 | 5% quarterly |
| (4) | ₹10 | 2500 | 2% per month |

**Solution:**

(1) Annual dividend on one share

$= 10\%$ of ₹10 = ₹$\left(\frac{10}{100}\times 10\right)$ = ₹1

Annual dividend on 500 shares

= ₹$(500 \times 1)$ = ₹500.

(2) Annual dividend on one share

= ₹$(2 \times 5)\%$ of ₹10

= ₹$\left(\frac{10}{100}\times 10\right)$ = ₹1

∴ Annual dividend on 800 shares

= ₹$(800 \times 1)$ = ₹800.

(3) Annual dividend on one share

= $(4 \times 5)\%$ of ₹100

= ₹$\left(\frac{20}{100}\times 100\right)$ = ₹20

∴ Annual dividend on 1500 shares

= ₹$(1500 \times 20)$ = ₹30000.

(4) Annual dividend on one share

= $(12 \times 2)\%$ of ₹10

= ₹$\left(\frac{24}{100}\times 10\right)$ = ₹2.40

∴ Annual dividend on 2500 shares

= ₹$(2500 \times 2.40)$ = ₹6000.

## TYPES OF SHARES

The shares are generally of two types:

(1) **Preferred shares** These shares get preference in terms of payment of dividend and return of capital over ordinary shares. The rate of dividend for these shares is decided when they are issued and dividend to preferred shareholders is paid before any dividend is paid to common shareholders.

(2) **Ordinary shares** Ordinary shareholders are paid dividend only when profits are left after preferred shareholders have been paid dividend at specified rate. The rate of dividend on these shares is also not fixed and depends upon the amount of available profit.

## FACE VALUE AND MARKET VALUE OF A SHARE

The price at which the shares are initially issued by a company to its shareholders is called the *face value* of a share (This is also called *nominal* or *par value* of a share). In fact, this is that value of a share which is mentioned in the share certificate issued by the company to its shareholders.

As other things, shares are also sold in (or purchased from) the market. The value of a share quoted in the market is called the *market value* of the share. The market value of a share keeps on changing according to its demand and supply changes.

If the market value of a share is equal to the par value of the share, the share is said to be *at par*. If the market value of a share is more than its face (or par) value, the share is said to be at *premium*. On other hand, if the market value of a share is less than its face value, the share is said to be *at discount* (or *below par*).
For example, if the market value of a ₹100 share is ₹130, it is said to be at 30% premium.

If the market value of a ₹100 share is ₹90, it is said to be at 10% discount. If ₹100 share is quoted at 45 premium then its market value is

$$₹(100 + 45) = ₹145.$$

Every company declares dividend on the face value of its shares irrespective of the market value of the share.

***Note:***

The statement, '32%, ₹100 shares at ₹125' means:
(1) Face value of each share is ₹100.
(2) Dividend on each share is 32% of the face value.
(3) Market value of each share is ₹125.
(4) An investment of ₹125 earns an annual income of ₹32.

**Illustration 2:** Find out the cost of purchasing 150 shares of a company, each of par value ₹10, quoted at ₹16 each in the market, from the original shareholder. Also, find out the gain to the new shareholder if he sells each share at a premium of ₹10.

**Solution:** Market value of share = ₹16

∴ Market value of 150 shares

$$= ₹(150 \times 16) = ₹2400$$

Thus, the new shareholder spent ₹2400 for buying 150 shares. The new shareholder sold the shares at a premium of ₹10.

∴ Now, market value of a share

$$= ₹(10 + 10) = ₹20$$

The selling price of 150 shares at the new market value = ₹(150 × 20) = ₹3000

∴ Gain of the new shareholder in the transaction

$$= ₹(3000 - 2400) = ₹600.$$

**Illustration 3:** Raja buys 200 shares, each of par value ₹10 of a company which pays annual dividend of 15% at such a price that he receives 12% on his investment. Find out the market value of a share.

**Solution:** Par value of 200 shares

$$= ₹(200 \times 10) = ₹2000.$$

Dividend received by Raja

$$= ₹\left(\frac{2000 \times 15}{100}\right) = ₹300.$$

Let, the market value of 200 shares be ₹$x$. We have to find $x$ such that 12% of $x$ = 300,

i.e., $\frac{12}{100} \times x = 300 \quad \therefore \quad x = \frac{100 \times 300}{12} = 2500$

i.e., Market value of 200 shares = ₹2500

Hence, the market value of one share = ₹12.50.

## STOCKS AND BROKERAGE

### Stock

In the previous section, we have learnt about shares, which can be sold and purchased by the public. The nominal value or face value of shares is fixed (usually ₹10 or ₹100), but their market value varies.

Sometimes, joint stock companies or the government also raises loans from the market by issuing *bonds* or *promisory notes*. They promise to pay a fixed amount (called *redemption value*) on a future date and interest payments at fixed periods until that time. The money paid to company or government for buying such bonds is called *stock*.

The stocks are usually known by their rates of dividend. Thus, by 9% stock we mean that the dividend on a ₹100 stock is ₹9.

If the market value of ₹100 stock, which yields a dividend of ₹5, is ₹115, the stock is called, '5% stock at 115. Similarly, 10% stock at 120 means that a stock of face value ₹100 gives a dividend of ₹10 and is available in the market of 120.

***Note:***

There can be stocks in units different from ₹100, say ₹500, ₹1000, etc., but the phrase, '8% stock at 90' can be used only in case of that stock whose face value is ₹100. Dividend on a stock is fixed (declared at the time of issue) whereas for a share it varies with time. Usually, the *date of maturity* of the stock is fixed. In case, the holder of the stock requires money before the due date, he may sell his stock to some other person, whereby his claim of interest is transferred to that person.

### Brokerage

The sale and purchase of stock is, generally, executed through a stockbroker who charges some money, called *Brokerage* from both the seller and buyer. *The brokerage is charged either as some fixed amount on each unit of stock or as some percentage of the market value of unit of stock.*

Thus, the brokerage of ₹$x$ means that $x$ rupees are to be added or subtracted from the market value of the stock. Similarly, brokerage 2% means that the brokerage equal to 2% of the market value of a unit of stock and be added to (or subtracted from) the market value of a unit of stock.

***Notes:***

(1) The brokerage is added to the market value when the stock is purchased.
(2) The brokerage is subtracted from the market value when the stock is sold.

## CALCULATION OF INCOME ON A STOCK

When the face value of the total stock is given, the income can be calculated on the assumption that the face value of each unit of stock is ₹100. On the contrary, if the market value of the total investment is given, the income can be calculated on the basis of the market value of a unit of stock.

**Illustration 4:** Find the income from ₹2875 of 4% stock.
**Solution:** By 4% stock, we mean a stock of ₹100 will fetch a dividend of ₹4 p.a.

Hence, the income from ₹2875 of 4% stock

$$= \frac{2875\times 4}{100} = ₹115.$$

**Illustration 5:** Find the income on 10% stock of ₹25000 purchased at ₹120.
**Solution:** Face value of stock = ₹25000

Income on ₹100 stock = ₹10

Income on ₹1 stock = ₹$\left(\frac{10}{100}\right)$

Income on ₹25000 stock = ₹$\left(\frac{25000\times 10}{100}\right)$

= ₹2500.

## COMPUTATION OF INVESTMENT OR MARKET VALUE OF A STOCK

If the face value of a stock is given, the market value of the stock can be found on the basis of market value of each unit of stock.

**Illustration 6:** Find out the investment required to purchase ₹75000 of 10% stock at 95.
**Solution:** Market value of ₹100 stock = ₹95

∴ Market value of ₹75000 stock

$$= ₹\left(\frac{95}{100}\times 75000\right) = ₹71250$$

∴ An investment of ₹71250 is required to purchase ₹75000 of 10% stock at ₹95.

**Illustration 7:** Find the investment required to get an income of ₹4200 from $10\frac{1}{2}$% stock at 80 (Brokerage: 2%).

**Solution:** Brokerage = 2% of ₹80 = ₹$\left(\frac{2}{100}\times 80\right)$

= ₹1.60

∴ Investment needed to buy ₹100 stock

= ₹81.60 on which the income is ₹$10\frac{1}{2}$

For income of ₹$10\frac{1}{2}$, the investment = ₹81.60

For income of ₹4200, the investment

$$= ₹\left(81.60\times \frac{2}{21}\times 4200\right) = ₹32640.$$

## COMPUTATION OF GAIN OR LOSS IN THE SALE AND PURCHASE OF A STOCK

When the market is favourable to stock holders, i.e., they are likely to get better proceeds for their stock, they sell the stock and may reinvest the money so obtained in another stock which may give them more income.

**Illustration 8:** Ram bought ₹12000 of 8% stock at 92 and sold it when the price rose to 98. Find his total gain and gain per cent.

**Solution:** Investment made by Ram in buying ₹12000 of 8% stock at 92

$$= ₹\left[12000 \times \frac{92}{100}\right] = ₹11040$$

When the price rose to ₹98, Ram sold the stock, thus money realized from selling the stock

$$= ₹\left[12000 \times \frac{98}{100}\right] = ₹11760$$

∴ Gain realized in the transaction

$$= ₹(11760 - 11040) = ₹720$$

∴ Gain per cent $= \dfrac{(720 \times 100)}{11040} - 3\dfrac{12}{23}\%$

## CHANGE IN INCOME ON SALE OR REINVESTMENT

A person having one type of stock may sell it to buy another which gives higher income. In such problems, the income in two cases is calculated and change is found out.

**Illustration 9:** Ram invests ₹46500 in 6% stock at 93 and sells the stock when its price rose to ₹95. He invests the sale proceeds in 9% stock at 95. Find out the change in Ram's income.

**Solution:** Income from first stock $= ₹\left(\dfrac{6}{93} \times 46500\right)$

$$= ₹3000$$

We have to find the amount realized on selling this stock.

Amount realized on selling ₹93 stock = ₹95

∴ Amount realized on selling ₹46500 stock

$$= ₹\frac{95}{93} \times 4650 = ₹47500$$

This amount is invested in 9% stock at 95.

∴ Income from the second stock

$$= ₹\left(\frac{9}{95} \times 47500\right) = ₹4500$$

Hence, increase in income

$$= ₹(4500 - 3000) = ₹1500.$$

## DEBENTURES

Sometimes, a running joint stock company may require more capital for its further expansion. The company borrows the required sum of money from the general public for a fixed period of time and at a fixed rate of interest by dividing the amount required into small parts. These small parts are called *debentures*.

The debenture-holders are creditors of the company and do not have any right on the profits declared by the company. However, interest at fixed rate and fixed time is payable to debenture-holders, irrespective of the fact whether the company is running in profits or losses.

Like shares, debentures can also be sold in or purchased from the market. The terms used in case of shares, are also used with the same meaning in case of debentures. Thus, we use the terms '*debentures at premium*', '*debentures at discount*', etc. Furthermore, the rules for calculating the brokerage on debenture are also the same as those in case of shares.

## DIFFERENCE BETWEEN SHARES ANDDEBENTURES

| | Shares | | Debentures |
|---|---|---|---|
| (a) | Share money forms a part of the capital of the company. | (a) | Debentures are a mere debt. |
| (b) | Shareholders have right on the profit declared by the company. | (b) | Debenture holders are creditors of the company and do not have any right on the profit declared by the company. |
| (c) | Shareholders may receive different dividend according as profit is more or less. | (c) | Debenture holders receive interest at a fixed rate. |

**Illustration 10:** Find the income per cent of a buyer on 8% debentures of face value ₹120 and available in the market at ₹180.

**Solution:** The market value of a debenture is ₹180.

∴ Income on ₹180 is ₹8.

∴ Income on ₹120 is $₹\left(\dfrac{8}{180} \times 120\right) = ₹5\dfrac{1}{3}$.

∴ Per cent income on the debenture is $5\dfrac{1}{3}\cdot\%$.

**Illustration 11:** Ram has 500 shares of par value ₹10 each of a company and 500 debentures of par value ₹100 each. The company pays a dividend of 8% on the shares and pays an interest of 10% on its debentures. Find the total annual income of Ram and the rate of return on her investments.

**Solution:** Annual dividend on 500 shares

$$= ₹\frac{(500 \times 10 \times 8)}{100}$$

$$= ₹400.$$

Annual interest on 500 debentures

$$= ₹\frac{(500 \times 100 \times 10)}{100}$$

$= ₹5000.$

$\therefore$ Total annual income of Ram

$= ₹(5000 + 400) = ₹5400.$

Total investment of Ram

$= ₹(500 \times 10 + 500 \times 100) = ₹55000$

Rate of return on Ram's investment

$$= \left(\frac{5400}{55000} \times 100\right)\%$$

$$= \frac{108}{11}\% \quad \text{or,} \quad 9\frac{9}{11}\%$$

## EXERCISE-I

**1.** A company declared an annual dividend of 10%. Find out the annual dividend of Ram owning 1500 shares of the company of par value ₹10 each.

(a) ₹1400 (b) ₹1500
(c) ₹1700 (d) ₹1600

**2.** A company declared an annual dividend of 10%. Find out the annual dividend received by Anu owning 4000 shares of the company having a par value of ₹100 each.

(a) ₹45000 (b) ₹40000
(c) ₹50000 (d) ₹60000

**3.** Jatin invested ₹27260 in buying ₹100 shares of a company at ₹116 each. If the company paid 16% dividend at the end of the year, find his income from the dividend.

(a) ₹3560 (b) ₹2760
(c) ₹3760 (d) ₹3660

**4.** A company issued 50000 shares of par value ₹10 each. If the total dividend declared by the company is ₹62500, then find out the rate of dividend paid by the company.

(a) $8\frac{1}{2}\%$ (b) $12\frac{1}{2}\%$
(c) 12% (d) $13\frac{3}{4}\%$

**5.** A company declared a semi-annual dividend of $7\frac{1}{2}\%$. Find out the annual dividend of Chetan, owning 1250 shares of the company having a par value of ₹10 each.

(a) ₹1875 (b) ₹1757
(c) ₹1680 (d) ₹1575

**6.** A medicine company issued 125000 shares of par value ₹20 each. If the total dividend declared by the company is ₹375000, find out the rate of dividend paid by the company.

(a) 15 % (b) 13%
(c) 10% (d) 14%

**7.** Seema had 50 preferred shares and 400 common shares of par value ₹100 each. If the dividend declared on preferred shares is 10% per annum and a semi-annual dividend of 7.5% is on common shares find the annual dividend received by Seema.

(a) ₹7500 (b) ₹6500
(c) ₹8500 (d) ₹5500

**8.** Find out the annual dividend received by Sunil for his 200 preferred shares and 1000 common shares, both of par value ₹100 each if the dividend declared on a preferred share is 10% per annum and an annual dividend of $12\frac{1}{2}\%$ on the common shares.

(a) ₹4500 (b) ₹550
(c) ₹4000 (d) ₹3500

**9.** A company issued 50000 shares of par value ₹100 each. If the total dividend declared by the company is ₹125000, out of which ₹50000 have been kept in reserve fund and the remaining is distributed as dividend, find out the rate of dividend paid by the company.

(a) $2\frac{3}{4}\%$ (b) $1\frac{1}{2}\%$
(c) $1\frac{1}{4}\%$ (d) 2%

**10.** Find the annual dividend received by Nishita from 1200 preferred shares and 3000 common shares both of par value ₹50 each if the dividend paid on preferred shares is 10% and semi-annual dividend of $3\frac{1}{2}\%$ is declared on common shares.

(a) ₹18500 (b) ₹16500
(c) ₹14500 (d) ₹14500

**11.** 12500 shares, of par value ₹20 each, are purchased from Ram by Mohan at a price of ₹25 each. Find out the amount required to purchase the shares. If Mohan further sells the shares at a premium of ₹11 each, then find out his gain in the transaction.

(a) ₹75000 (b) ₹85000
(c) ₹70000 (d) ₹65000

**12.** Mac buys 200 shares of par value ₹10 each, of a company, which pays an annual dividend of 8% at such a price that he gets 10% on his investment. Find the market value of share.

(a) ₹8 (b) ₹10
(c) ₹6 (d) ₹12

**13.** Shyam purchased 12000 shares of a company, of par value ₹10 each, paying an annual dividend of 15% at such a price that she gets 10% on her investment. Find the market value of a share.

(a) ₹25 (b) ₹15
(c) ₹20 (d) ₹14

**14.** The capital of a company is made up of 50000 preferred shares with dividend of 20% and 20000 common shares, the par value of each type of share being ₹10. The company had a total profit of ₹180000 out of which ₹30000 were kept in reserve fund and the remaining distributed to shareholders. Find out the dividend per cent to the common shareholders.

(a) 24% (b) 20%
(c) 25% (d) 30%

**15.** A company has issued 10000 preferred shares and 50000 common shares both of par value ₹100 each. The dividend on a preferred share and a common share is 12% and 17.6%, respectively. The company had a total profit of ₹15 Lakhs, out of which some amount was kept in reserve fund and the remaining distributed as dividend. Find out the amount kept in reserve fund.

(a) ₹5 Lakhs (b) ₹6 Lakhs
(c) ₹6.5 Lakhs (d) ₹5.5 Lakhs

**16.** A man sells 5000 common shares of Company X (each of par value ₹10), which pays a dividend of 20%, at ₹30 per share. He invests the sale proceeds in ordinary shares of Company Y (each of par value ₹25) that pays a dividend of 15%. If the market value of a share of Company Y is ₹40, find out the number of shares of Company Y purchased by the man.

(a) 3850 (b) 3750
(c) 3700 (d) 3800

**17.** The shares of a company of par value ₹10 each, are available at 20% premium. Find out the amount paid by the buyer who wants to buy 2500 shares. What would be the gain of the buyer if he sells those shares at the rate of ₹20 per share?

(a) ₹25000 (b) ₹30000
(c) ₹20000 (d) ₹22000

**18.** Find the income on 12% stock of ₹60000 purchased at ₹110.

(a) ₹7200 (b) ₹7500
(c) ₹7400 (d) ₹8200

**19.** Find the income on $7\frac{1}{2}$% stock of ₹20000 purchased at ₹120.

(a) ₹1550 (b) ₹1450
(c) ₹1500 (d) ₹1600

**20.** Find the income by investing ₹81000 in 9% stock at 135.

(a) ₹5500 (b) ₹6400
(c) ₹5400 (d) ₹6000

**21.** Find the income obtained by investing ₹90000 in $7\frac{1}{2}$% stock at $112\frac{1}{2}$.

(a) ₹6000 (b) ₹6500
(c) ₹7500 (d) ₹7000

**22.** A person buys $9\frac{1}{2}$% stock of ₹72000 at 144. Find his annual income.

(a) ₹6640 (b) ₹6840
(c) ₹6900 (d) ₹7240

**23.** Mr Lal invested ₹92000 in $9\frac{1}{2}$% stock at 91 (Brokerage: ₹1). Find out the annual income of Mr Lal from this investment.

(a) ₹9000 (b) ₹9500
(c) ₹10500 (d) ₹8000

**24.** Raja invested ₹99000 in $7\frac{1}{2}$% stocks at $81\frac{1}{2}$ (Brokerage: ₹1). Find out Ram's annual income from his investment.

(a) ₹9500 (b) ₹10000
(c) ₹10500 (d) ₹9000

**25.** Ram invested ₹88008 in $9\frac{1}{2}$% stock at 112 (Brokerage: ₹2). Find out annual income of Ram from this investment.

(a) ₹6334 (b) ₹6874
(c) ₹7334 (d) ₹6534

**26.** Find the investment required to purchase ₹125000 of 8% stock at 92.

(a) ₹115000 (b) ₹120000
(c) ₹105000 (d) ₹125000

**27.** What investment will be required to purchase ₹90000 of 8% stock at 110?

(a) ₹88000 (b) ₹99000
(c) ₹88500 (d) ₹9950

**28.** Find out the investment required to get an income of ₹1938 from $9\frac{1}{2}$% stock at 90 (Brokerage 1%).

(a) ₹19642.60 (b) ₹17543.00
(c) ₹18543.60 (d) ₹18600.60

**29.** A man bought ₹20000 of 5% stock at 90 and sold it when its price rose to ₹$93\frac{3}{4}$. Find out his gain per cent.

(a) $5\frac{1}{6}$% (b) $4\frac{1}{6}$%
(c) $5\frac{5}{6}$% (d) $4\frac{5}{6}$%

**30.** Meena bought ₹36000 of $7\frac{1}{2}$% stock at 92 and sold it when its price rose to ₹$93\frac{3}{4}$. Find out her gain per cent.

(a) 1.9% (b) 2.9%
(c) 2.3% (d) 1.4%

**31.** A man invests ₹27600 in 4% stock at 92. He sold ₹20000 stock when the price rose to ₹96, and sold the remaining stock when the market value fell to ₹90. How much does he gain or loss in the transaction?

(a) Gain = ₹600 (b) Loss = ₹600
(c) Loss = ₹650 (d) Gain = ₹650

**32.** A person invests ₹28500 in 5% stock at 95. He sold ₹15000 stock when the price rose to ₹98 and sold the remaining stock when the market value of the stock fell to ₹90. How much does he gain or loss in the transaction?

(a) Gain = ₹300 (b) Loss = ₹300
(c) Gain = ₹400 (d) Loss = ₹400

**33.** Sushma invested ₹245000 in 7% stock at 98 and sold the stock when its price rose to ₹100. She invested the sale proceeds in 9% stock at 125. Find out the change in income of Sushma.

(a) ₹600 (b) ₹400
(c) ₹500 (d) ₹650

**34.** Anu invested ₹32400 in 8% stock at 90. She sold out ₹18000 stock when the price rose to ₹95 and the remaining stock at ₹98. She invested the total sale proceeds in 10% stock at $96\frac{1}{2}$. Find the change in income of Anu.

(a) ₹750 (b) ₹720
(c) ₹760 (d) ₹740

**35.** A man invested ₹50490 in 5% stock at 99 and sold it when the price rose to ₹102. He invested the sale proceeds in 8% stock at 96. Find out the change in man's income (Brokerage: ₹3)

(a) ₹1485
(b) ₹1585
(c) ₹1385
(d) ₹1685

**36.** A man invested ₹260000 in 5% stock at 104. He sold the stock when the price rose to ₹125 and invested the sale proceeds in 6% stock. By doing this his income increased by ₹2500. At what price did he purchase the second stock?

(a) ₹225 (b) ₹175
(c) ₹125 (d) ₹150

**37.** Find out the income per cent of a buyer on 5% debentures of face value ₹95 and available in the market for ₹125.

(a) 4.8% (b) 5.8%
(c) 3.8% (d) 2.8%

**38.** Find out the income per cent on 10% debentures of par value ₹120 available in the market for ₹150.

(a) 9% (b) 8%
(c) 7% (d) 6%

**39.** Brij has 800 shares of par value ₹50 each and 600 debentures of par value ₹100 each of the company. The company pays an annual dividend of 6% on the shares and interest of 12% on the debentures. Find out the total annual income of Brij and rate of return on his investment.

(a) ₹9600, 9.6% (b) ₹8000, 8%
(c) ₹10600, 10.6% (d) ₹9000, 8.6%

**40.** A man bought 20 shares of ₹50 at 5 discount, the rate of discount being $4\frac{3}{4}$%. The rate of interest obtained is:

(a) $4\frac{3}{4}$% (b) $3\frac{1}{4}$%
(c) 5.28% (d) 4.95%

## Exercise-2
## (Based on Memory)

1. A sum of ₹2236 is divided among A, B and C such that A receives 25% more than C and C receives 25% less than B. What is A's share in the amount?

   (a) ₹460 (b) ₹890
   (c) ₹780 (d) ₹1280

   **[IOB PO Examination, 2009]**

2. A sum of money is divided among A, B, C and D in the ratio of 2:3:7:11, respectively. If the share of C is ₹2755 more than the share of A, then what is the total amount of money of B and D together?

   (a) ₹4408 (b) ₹5510
   (c) ₹6612 (d) ₹7714

   **[SBI PO Examination, 2008]**

3. Mrudul invested an amount of ₹29500 in order to start a business. Shalaka joined her 4 months later by investing an amount of ₹33500. If the business earned a profit of ₹120575 at the end of two years, what was Mrudul's share of the profit?

   (a) ₹60725 (b) ₹61950
   (c) ₹59250 (d) ₹58625

   **[Indian Bank PO Examination, 2011]**

4. Rahul spends 50% of his monthly income on household items, 20% of his monthly income on buying clothes, 5% of his monthly income on medicines and the remaining amount of ₹11250 he saves. What is Rahul's monthly income?

   (a) ₹38200 (b) ₹34000
   (c) ₹41600 (d) ₹45000

   **[IDBI PO Examination, 2009]**

5. Sonu invested 10% more than Mona. Mona invested 10% less than Raghu. If the total sum of their investment is ₹5780, how much amount did Raghu invest?

   (a) ₹2010 (b) ₹2000
   (c) ₹2100 (d) ₹2210

   **[Bank of Baroda PO Examination, 2010]**

6. In a business partnership among A, B, C and D, the profit is shared as follows

   $$\frac{\text{A's share}}{\text{B's share}} = \frac{\text{B's share}}{\text{C's share}} = \frac{\text{C's share}}{\text{D's share}} = \frac{1}{3}$$

   If the total profit is ₹4,00,000 the share of C is

   (a) ₹1,12,500 (b) ₹1,37,500
   (c) ₹90,000 (d) ₹2,70,000

   **[SSC (GL) Examination, 2011]**

| ANSWER KEYS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Exercise-1** | | | | | | | | | | | | |
| **1.** (b) | **2.** (b) | **3.** (c) | **4.** (b) | **5.** (a) | **6.** (a) | **7.** (b) | **8.** (a) | **9.** (b) | **10.** (b) | **11.** (a) | **12.** (a) | **13.** (b) |
| **14.** (c) | **15.** (a) | **16.** (b) | **17.** (c) | **18.** (a) | **19.** (c) | **20.** (c) | **21.** (a) | **22.** (b) | **23.** (b) | **24.** (d) | **25.** (c) | **26.** (a) |
| **27.** (b) | **28.** (c) | **29.** (b) | **30.** (a) | **31.** (a) | **32.** (b) | **33.** (c) | **34.** (b) | **35.** (a) | **36.** (c) | **37.** (c) | **38.** (b) | **39.** (a) |
| **40.** (c) | | | | | | | | | | | | |
| **Exercise-2** | | | | | | | | | | | | |
| **1.** (c) | **2.** (d) | **3.** (b) | **4.** (d) | **5.** (b) | **6.** (c) | | | | | | | |

# EXPLANATORY ANSWERS

## EXERCISE-I

1. **(b)** Annual dividend on one share
= 10% of ₹10
$= ₹\left(10 \times \frac{10}{100}\right) = ₹1$
Annual dividend of Ram owning 1500 shares
= (1500 ×1) = ₹1500.
Alternatively, we could have found the total par value of 1500 shares first and then find dividend at 10% of it as shown below:
Total par value of 1500 shares
= ₹(1500 × 10)= ₹15000
∴ Total annual dividend of Ram
$= \left(15000 \times \frac{10}{100}\right) = ₹1500.$

2. **(b)** Annual dividend on one share = 10% of ₹100
$= ₹\left(\frac{10}{100} \times 100\right) = ₹10$
∴ Annual dividend on 4000 shares
= ₹(4000 × 10) = ₹40000.

3. **(c)** Number of shares purchased by Jatin
$= \frac{27260}{116} = 235.$
Face value of 235 shares
= ₹(235 × 100) = ₹23500.
Annual income from 235 shares
= 16% of ₹23500
$= ₹\left(\frac{16}{100} \times 23500\right) = ₹3760.$

4. **(b)** Number of shares = 50000
Par value of a share = ₹10
∴ Total par value of 50000 shares = ₹500000
Total dividend = ₹62500
∴ Rate of dividend paid by the company
$= \left(\frac{62500}{500000} \times 100\right)\% = 12\frac{1}{2}\%.$

5. **(a)** Annual dividend on one share = $\left(2 \times 7\frac{1}{2}\right)\%$
i.e., 15% of ₹10
$= \left(\frac{15}{100} \times 10\right) = ₹1.50$
∴ Annual dividend on 1250 shares
= ₹(1250 × 1.50) = ₹1875.

6. **(a)** Number of shares = 125000
Par value of a share = ₹20
∴ Total par value of 125000 shares
= ₹(1250000 × 20) = ₹2500000
Total dividend = ₹375000
∴ Rate of dividend paid by the company
$= \left(\frac{375000}{2500000} \times 100\right)\% = 15\%.$

7. **(b)** Dividend on 50 preferred shares
$= ₹\left(50 \times 100 \times \frac{10}{100}\right) = ₹500$
Dividend on 400 common shares
$= ₹\left(400 \times \frac{100}{100} \times \frac{15}{2} \times 2\right) = ₹6000.$
∴ Total dividend received by Seema
= ₹(500 + 6000) = ₹6500.

8. **(a)** Dividend on 200 preferred shares
= 10% of ₹(200 × 100)
$= ₹\left(\frac{10}{100} \times 20000\right) = ₹2000$
Dividend on 1000 common shares
$= 12\frac{1}{2}\%$ of ₹(1000 × 100)
$= ₹\left(\frac{25/2}{100} \times 100000\right)$
$= ₹\left(\frac{25}{2} \times 1000\right) = ₹12500$
∴ Total dividend received
= ₹(2000 + 12500) = ₹4500.

9. **(b)** Total dividend declared = ₹125000
Amount kept in reserve fund = ₹50000
Net amount paid as dividend to the shareholders
= ₹(125000 − 50000) = ₹75000
Number of shares of par value ₹100 each = 50000
Total par value of 50000 shares
= ₹(50000 × 100) = ₹5000000
Rate of dividend paid by the company
$= \left(\frac{75000}{5000000} \times 100\right)\% = \frac{3}{2}\% = 1\frac{1}{2}\%.$

10. **(b)** Dividend on 1200 preferred shares
= 10% of ₹(1200 × 50)
$= ₹\left(\frac{10}{100} \times 1200 \times 50\right) = ₹6000$
Dividend on 3000 common shares
$= \left(3\frac{1}{2} \times 2\right)\%$ of ₹(3000 × 50)

$= ₹\left(\frac{7}{100} \times 3000 \times 50\right) = ₹10500$

∴ Total dividend received by Nishita

= ₹(6000 + 10500) = ₹16500.

**11. (a)** Market value of a share = ₹25

∴ Market value of 12500 shares

= ₹(25 × 12500) = ₹312500

Thus, the amount required to purchase 12500 shares = ₹312500

Then, Mohan sells these shares at a premium of ₹11 each.

∴ New market rate per shares

= ₹(20 + 11) = ₹31

∴ Selling price of these shares

= ₹(31 × 12500) = ₹387500

∴ Gain = S.P. − C.P. = ₹(387500 − 312500)

= ₹75000.

**12. (a)** Par value of 200 shares = ₹(200 × 10)= ₹2000

Dividend received by Mac $= ₹\left(\frac{8}{100} \times 2000\right)$

= ₹160

Let, the market value of 200 shares be ₹$x$.

We have to find $x$ such that 10% of $x$ = 160

$\Rightarrow \frac{10}{100} \times x = 160 \Rightarrow x = 160 \times 10 = 1600$

i.e., Market value of 200 shares = ₹1600.

Hence, the market value of one share

$= ₹\left(\frac{1600}{200}\right) = ₹8.$

**13. (b)** Par value of 12000 shares = ₹(12000 × 10)

= ₹120000

Dividend received by Shyam $= ₹\left(\frac{15}{100} \times 120000\right)$

= ₹18000

Let, the market value of 12000 shares be ₹$x$.

We have to find $x$ such that 10% of $x$ = 18000

$\Rightarrow \frac{10}{100} \times x = 18000 \Rightarrow x = 18000 \times 10 = 180000$

i.e., Market value of 12000 shares = ₹180000.

Hence, the market value of one share

$= ₹\left(\frac{180000}{12000}\right) = ₹15.$

**14. (c)** The total profit of the company = ₹180000.

Amount kept in reserve fund = ₹30000

∴ Net amount paid as dividend to shareholders

= ₹(180000 − 30000) = ₹150000

Dividend paid by the company on 50000 preferred shares

$= ₹\left(50000 \times \frac{10 \times 20}{10}\right) = ₹100000$

∴ Dividend to be paid to common shareholders

= ₹(150000 − 100000) = ₹50000.

Thus, dividend paid on a common share

$= ₹\left(\frac{50000}{20000}\right) = ₹2.50$

Hence, dividend per cent paid on a common share

$= ₹\left(\frac{2.50}{10} \times 100\right)\% = 25\%.$

**15. (a)** 12% of ₹(10000 × 100)

$= ₹\left(\frac{12}{100} \times 10000 \times 100\right) = ₹120000$

Dividend on 50000 common shares

= 17.6% of ₹(50000 × 100)

$= ₹\left(\frac{17.6}{100} \times 50000 \times 100\right) = ₹880000$

∴ Total dividend paid = ₹(120000 + 880000)

= ₹1000000 = ₹10 Lakhs

∴ Amount kept in reserve fund

= ₹15 Lakhs − 10 Lakhs = ₹5 Lakhs.

**16. (b)** Income of the man from 5000 ordinary shares of Company X, which pays a dividend of 20%

$= ₹\left(\frac{5000 \times 10 \times 20}{100}\right) = ₹10000.$

Selling price of a share of Company X = ₹30

∴ Selling price of 5000 shares of Company X

= ₹(5000 × 30)

= ₹150000.

Now, the market value of a share of Company Y is given to be ₹40.

∴ Number of shares of Company Y purchased by the man from ₹150000

$= \left(\frac{150000}{40}\right) = ₹3750.$

**17. (c)** Par value of a share = ₹10

Market value of a share $= ₹\left(10 \times \frac{120}{100}\right) = ₹12$

The amount to be paid by the buyer to purchase 2500 shares = ₹(2500 × 12) = ₹30000.

Gain of the shareholder on selling one share

= ₹(20 − 12) = ₹8.

∴ Gain from selling 2500 shares

= ₹(2500 × 8) = ₹20000.

**18. (a)** Face value of the stock = ₹60000

Income on ₹100 stock = ₹12

Income on ₹1 stock = ₹$\left(\frac{12}{100}\right)$

Income on ₹60000 = ₹$\left(\frac{12}{100}\times 60000\right)$ = ₹7200.

**19.** **(c)** Face value of the stock = ₹20000

Income on ₹100 stock = ₹$7\frac{1}{2}$

Income on ₹1 stock = ₹$\left(\frac{15/2}{100}\right)$ = ₹$\left(\frac{15}{200}\right)$

Income on ₹20000 stock = ₹$\left(\frac{15}{200}\times 20000\right)$
= ₹1500.

**20.** **(c)** Here, the market value of the stock
= ₹81000.

By investing ₹135, stock of par value ₹100 is available

∴ Income on ₹135 is ₹9.

∴ Income on ₹81000 is ₹$\left(\frac{9}{135}\times 81000\right)$ = ₹5400.

**21.** **(a)** Here, market value of the stock = ₹90000.

By investing ₹$112\frac{1}{2}$, stock of par value ₹100 is available.

∴ Income on ₹$112\frac{1}{2}$ is $7\frac{1}{2}$%

∴ Income on ₹90000 is ₹$\left(\frac{15}{2}\times\frac{2}{225}\times 90000\right)$
= ₹6000.

**22.** **(b)** Face value of the stock = ₹72000

∴ Income on stock = ₹$\left(\frac{72000}{100}\times\frac{19}{2}\right)$ = ₹6840.

**23.** **(b)** Market value of ₹100 stock
= ₹(91 + 1) = ₹92

Income on ₹92 = ₹$9\frac{1}{2}$

∴ Income on ₹92000 = ₹$\left(\frac{19}{2}\times\frac{19}{92}\times 92000\right)$
= ₹9500.

**24.** **(d)** Market value of ₹100 stock

= ₹$\left(81\frac{1}{2}+1\right)$ = ₹$82\frac{1}{2}$

Income on ₹$82\frac{1}{2}$ = ₹$7\frac{1}{2}$

∴ Income on ₹99000 = ₹$\left(\frac{15}{2}\times\frac{2}{165}\times 99000\right)$
= ₹9000.

**25.** **(c)** Market value of ₹100 stock
= ₹(112 + 2) = ₹114

Income on ₹114 = ₹$9\frac{1}{2}$

∴ Income on ₹88008 = ₹$\frac{19}{2}\times\frac{1}{114}\times 88008$
= ₹7334.

**26.** **(a)** Market value of ₹100 stock = ₹92

∴ Market value of ₹125000 stock

= ₹$\left(\frac{92}{100}\times 125000\right)$ = ₹115000.

∴ An investment of ₹115000 is required to purchase ₹125000 of 8% stock at 92.

**27.** **(b)** Market value of ₹100 stock = ₹110.

∴ Market value of ₹90000 stock

= ₹$\left(\frac{110}{100}\times 90000\right)$ = ₹99000

∴ An investment of ₹99000 is required to purchase ₹90000 of 8% stock at 110.

**28.** **(c)** Brokerage = 1% ₹90 = ₹0.90

∴ Investment needed to buy ₹100 stock
= ₹90.90 on which the income is ₹9%

For income of ₹$9\frac{1}{2}$, the investment = ₹90.90

For income of ₹1938, the investment

= ₹$\left(\frac{90.90\times 2}{19}\times 1938\right)$ = ₹18543.60.

**29.** **(b)** Investment made by the man in buying ₹20000 of 5% stock at 90 = ₹$\left(\frac{90}{100}\times 20000\right)$ = ₹18000.

When the price rose to ₹$93\frac{3}{4}$, the man sold the stock. Thus, money realized from selling the stock

= ₹$\left(\frac{375}{4}\times\frac{1}{100}\times 20000\right)$ = ₹18750

∴ Gain in the transaction
= ₹(18750 − 18000) = ₹750

∴ Gain per cent = $\left(\frac{750}{18000}\times 100\right)\% = 4\frac{1}{6}\%$

**30.** **(a)** Investment made by Meena in buying ₹36000 of $7\frac{1}{2}$% stock at 92 = ₹$\left(\frac{92}{100}\times 36000\right)$ = ₹33120.

When the price rose to ₹$93\frac{3}{4}$, Meena sold the stock. Thus, money realized from selling the stock

= ₹$\left(\frac{375}{4}\times\frac{1}{100}\times 36000\right)$ = ₹33750

∴ Gain in the transaction
= ₹(33750 − 33120) = ₹630

∴ Gain per cent = $\left(\frac{630}{33120}\times 100\right)\%$ = 1.9 (approx).

**31.** **(a)** Stock purchased by investing ₹27600 in 4% stock at 92

$= ₹\left(\dfrac{27600 \times 100}{92}\right) = ₹30000.$

Money realized by selling ₹20000 stock at market value of ₹96

$= ₹\left(\dfrac{20000 \times 96}{100}\right) = ₹19200.$

Remaining stock = ₹(30000 − 20000) = ₹10000.

Money realized by selling ₹10000 stock at ₹90

$= ₹\left(10000 \times \dfrac{90}{100}\right) = ₹9000.$

∴ Total money realized by selling the whole stock

= ₹(19200 + 9000) = ₹28200.

Money invested = ₹27600

∴ Gain = ₹(28200 − 27600) = ₹600.

**32.** **(b)** Stock purchased by investing ₹28500 in 5% stock at 95

$= ₹\left(\dfrac{100}{95} \times 28500\right) = ₹30000$

Money realized by selling ₹15000 stock market value of ₹98.

$= ₹\left(\dfrac{98}{100} \times 15000\right) = ₹14700$

Remaining stock = ₹(30000 − 15000) = ₹15000

Money realized by selling ₹15000 stock at ₹90

$= ₹\left(\dfrac{90}{100} \times 15000\right) = ₹13500$

∴ Total money realized

= ₹(14700 + 13500) = ₹28200

Money invested = ₹28500

∴ Loss = ₹(28500 − 28200) = ₹300.

**33.** **(c)** Income from first stock $= ₹\left(\dfrac{7}{98} \times 245000\right) = ₹17500$

We have to find the amount realized on selling this stock.

Amount realized on selling ₹98 stock = ₹100

∴ Amount realized on selling ₹245000 stock

$= ₹\left(\dfrac{100}{98} \times 245000\right) = ₹250000$

This amount is invested in 9% stock at 125

∴ Income from second stock

$= ₹\left(\dfrac{9}{125} \times 250000\right) = ₹18000$

Hence, increase in income

= ₹(18000 − 17500) = ₹500.

**34.** **(b)** Income from first stock

$= ₹\left(\dfrac{8}{90} \times 32400\right) = ₹2880$

Amount of stock purchased by Anu

$= ₹\left(\dfrac{100}{90} \times 32400\right) = ₹36000$

Amount received by selling ₹18000 stock at 95

$= ₹\left(\dfrac{95}{100} \times 18000\right) = ₹17100$

Amount received by selling the remaining ₹18000 stock at 98

$= ₹\left(\dfrac{98}{100} \times 18000\right) = ₹17640$

∴ Total amount received

= ₹(17100 + 17640) = ₹34740

The amount of ₹34740 is invested in 10% stock at $96\dfrac{1}{2}$

∴ Income from this stock

$= ₹\left(10 \times \dfrac{2}{193} \times 34740\right) = ₹3600$

Hence, change in income

= ₹(3600 − 2880) = ₹720.

**35.** **(a)** Purchase price of first stock

= ₹(99 + 3) = ₹102

∴ Income on first stock

$= ₹\left(\dfrac{5}{102} \times 50490\right) = ₹2475$

Sale price of stock = ₹(102 − 3) = ₹99

∴ Amount received by selling the first stock

$= ₹\left(\dfrac{99}{102} \times 50490\right) = ₹49005$

Purchase price of the second stock

= ₹(96 + 3) = ₹99

∴ Income on second stock

$= ₹\left(\dfrac{8}{99} \times 49005\right) = ₹3960$

Hence, change in income

= ₹(3960 − 2475) = ₹1485.

**36.** **(c)** Income on first stock $= ₹\left(\dfrac{5}{104} \times 260000\right) = ₹12500$

Money realized by selling the stock when price rose to ₹125

$= ₹\left(\dfrac{125}{104} \times 260000\right) = ₹312500$

Income on second stock is ₹2500 more on the first stock

∴ Income on second stock

= ₹(12500 + 2500) = ₹15000

Let, ₹$x$ be the market value of the second stock

$\therefore \quad \dfrac{312500 \times 6}{x} = 15000 \Rightarrow x = \dfrac{312500 \times 6}{15000} = 125$

i.e., The man purchased the stock at ₹125.

**37.** **(c)** The market value of a debenture = ₹125

$\therefore$ Income on ₹125 is ₹5.

$\therefore$ Income on ₹95 is ₹$\left(\frac{5}{125}\times 95\right)$ = ₹$\frac{19}{5}$.

$\therefore$ Per cent income on the debentures is 3.8%

**38.** **(b)** The market value of a debenture = ₹150.

$\therefore$ Income on ₹150 is ₹10.

$\therefore$ Income on ₹120 = ₹$\left(\frac{10}{150}\times 120\right)$ = ₹8

$\therefore$ Per cent income on the debentures = 8%.

**39.** **(a)** Annual dividend on 800 shares

= ₹$\left(\frac{800\times 50\times 6}{100}\right)$ = ₹2400

Annual interest on 600 debentures

= ₹$\left(\frac{600\times 100\times 12}{100}\right)$ = ₹7200

$\therefore$ Total annual income of Brij

= ₹(2400 + 7200) = ₹9600

Total investment of Brij

= ₹(800 × 50 + 600 × 100)

= ₹(40000 + 60000)

= ₹100000

$\therefore$ Rate of return = $\left(\frac{9600}{100000}\times 100\right)$% = 9.6%

**40.** **(c)** Face value = ₹(50 × 20) = ₹1000

Dividend = ₹$\left(\frac{1000\times 19}{4\times 100}\right)$ = ₹$\left(\frac{95}{2}\right)$

Investment = ₹(45 × 20) = ₹900

Rate = ₹$\left(\frac{95\times 100}{2\times 900}\right)$ = 5.28%

## Exercise-2
## (Based on Memory)

**1.** **(c)** Suppose B got ₹$x$.

Amount to C = $x - x \times \frac{25}{100}$

$= \frac{100x - 25x}{100}$

$= \frac{75x}{100} = ₹\frac{3x}{4}$

So, the amount to A = $\frac{3x}{4}\times\frac{125}{100} = \frac{15x}{16}$

A:B:C = $\frac{15x}{16} : x : \frac{3x}{4}$

= $15x:16x:12x$

Sum of the ratio = $15x + 16x + 12x = 43x$

$\therefore$ Share of A = $\frac{2236\times 15x}{43x}$ = ₹780

**2.** **(d)** Suppose the amount of A, B, C and D are $2x$, $3x$, $7x$, $11x$.

$\because$ $7x - 2x = 2755$

$\therefore$ $5x = 2755$

$x = \frac{2755}{5} = 551$

$\therefore$ Total amount of B and D

= $(3 + 11)x$

= 14 × 551 [$x$ = 551]

= 7714

**3.** **(b)** Monthly investment by Mrudul

= 29500 × 24 = 708000

and by Shalaka = 33500 × 20 = 670000

Ratio = 708000:670000

= 708:670

Share of Mrudul = $\frac{708}{708+670}$ × 120575 = 61950

**4.** **(d)** Suppose monthly income is $x$

$x \times \frac{(100-75)}{100} = 11250$

$\Rightarrow$ $x \times \frac{25}{100} = 11250$

$\Rightarrow$ $x \times \frac{1}{4} = 11250$

$\Rightarrow$ $x = 11250 \times 4$

$x$ = ₹45000

Short cut

$\frac{100}{(100-50-20-5)}$ × 11250 = ₹45000

**5.** **(b)** Suppose amount invested by Raghu = ₹$x$

Amount invested by Mona

$= \frac{9}{10}x = 0.9x$

Amount invested by Sonu

$= \frac{9}{10}x\times\frac{110}{100} = 0.99x$

$x + 0.9x + 0.99x = 5780$

$2.89x = 5780$

$x = \dfrac{5780}{2.89} = ₹2000$

**6.** **(c)** A's share = $\frac{1}{3}$ of B's share

B's share = $\frac{1}{3}$ of C's share

C's share = $\frac{1}{3}$ of D's share

Let, D's share be ₹$x$, then

C's share $= \frac{1}{3}x$

B's share $= \frac{1}{9}x$

A's share $= \frac{1}{27}x$

And, so

$$x + \frac{1}{3}x + \frac{1}{9}x + \frac{1}{27}x = 4,00,000$$

$\Rightarrow \quad x = 2,70,000$

$\therefore \quad$ C's share $= \frac{1}{3}x = \frac{1}{3} \times 2,70,00$

$= ₹90,000$

# Discount (True and Banker's) 21

## INTRODUCTION

Suppose, a man buys a pen at a credit of one year for ₹105 at 5% simple interest. If the money is to be paid immediately, he shall give ₹100. ₹100 is the *present value* or *present worth* of ₹105 due in 1 year. Hence, the sum due (₹105) is called the *amount* and the reduction made in consideration of making the immediate payment is called *true discount*.

### Present Value

The *present value* or *present worth* of a sum of money due at the end of a given time is that sum which with its interest for the given time at the given rate will amount to the sum due.

### True Discount (T.D.)

The *true discount* is the difference between the sum due at the end of a given time and its present worth.
Thus, T.D. = Amount (A) − present worth (P.W.)
In the above case, T.D. = ₹(105 − 100) = ₹5.

***Note:***

1. Clearly, T.D. is the Interest on P.W. and

   A = P.W. + T.D.

2. Interest is reckoned on P.W. and T.D. is reckoned on amount.

### Banker's Discount

Suppose, businessman A purchases goods worth ₹10000 from businessman B at a credit of 3 months. Thus, B prepares a bill, called the *bill of exchange*. On receipt of the goods, A gives an agreement and signs the bill accepting that the money can be withdrawn from his account after 3 months of the date of the bill. Accordingly, A orders his bank to pay ₹10000 to B after 3 months. Besides, 3 days grace period is also added to this date (named *nominally due date*) of expiry of 3 months to arrive at a date called *legally due date*. Thus, if April 4, 2004 is the nominally due date then April 7, 2004 will be legally due date. The amount of ₹10000 is called the *face value*.

Now, suppose, B needs the money of this bill earlier than April 7, say March 7. In such a case, B can approach the banker or broker to pay him the money against the bill. Obviously, in such a situation, the money paid by the banker will be less than the face value of the bill. Now, suppose, the bill is presented to the banker on March 7, 2004, then the banker will deduct the interest on the face value for the period March 7, 2004 to April 7, 2004 and this interest is called the *Banker's Discount* (B.D.) or *Commercial Discount*.

Thus, Banker's Discount is the simple interest on the face value for the period from the date on which the bill was discounted and the legally due date. The amount mentioned in the bill is called the *face value* of the bill. It may be noted that *banker's discount* is greater than the *true discount*, because while the true discount is the interest on the present worth, banker's discount is the interest on sum due.

The difference between the present worth and cash value of a bill is called the *banker's gain* (B.G.). Thus, the interest on the bill value (or the face value) is called the banker's discount (B.D) and the difference between the banker's discount and true discount (T.D.) is called banker's gain (B.G.)

> We have the following results.
>
> Banker's gain = Banker's discount − True discount
>
> = Interest on sum due − Interest on present worth
>
> = Interest on (sum due − present worth)
>
> = Interest on true discount.

## SOME BASIC FORMULAE

1. If rate = $R$% p.a. and time = $T$ years, then

(i) $\text{P.W.} = \dfrac{100\times A}{100+R\times T} = \dfrac{100\times \text{T.D.}}{R\times T}$

**Illustration 1:** Find the present worth of ₹8700 due in 3 years at 15% per annum at simple interest. Also, find the true discount.

**Solution:** $\text{P.W.} = \dfrac{100\times A}{100+R\times T} = \dfrac{100\times 8700}{100+15\times 3}$

$= \dfrac{100\times 8700}{145}$ = ₹6000

T.D. = Amount − P.W. = 8700 − 6000 = ₹2700.

(ii) $\text{T.D.} = \dfrac{\text{P.W.}\times R\times T}{100} = \dfrac{A\times R\times T}{100+R\times T}$

**Illustration 2:** Find the true discount and the sum for 15 months, hence whose present value at 8% is ₹1000.

**Solution:** $\text{T.D.} = \dfrac{\text{P.W.}\times R\times T}{100} = \dfrac{1000\times 8\times 15}{100\times 12}$

= ₹100.

Sum due = P.W. + T.D.

= 1000 + 100 = ₹1100.

**Illustration 3:** Find the true discount reckoning 3% p.a. simple interest on ₹1802 due in 2 year's time.

**Solution:** $\text{T.D.} = \dfrac{A\times R\times T}{100+R\times T} = \dfrac{1802\times 3\times 2}{100+3\times 2}$ = ₹102.

(iii) $\text{Sum (A)} = \dfrac{\text{S.I.}\times \text{T.D.}}{\text{S.I.}-\text{T.D.}}$

**Explanation**

$$\frac{\text{S.I.}\times\text{T.D.}}{\text{S.I.}-\text{T.D.}} = \frac{\left(A\times R\times \dfrac{T}{100}\right)\times \text{T.D.}}{\left(\text{T.D.}\times R\times \dfrac{T}{100}\right)} = A$$

$$\therefore \quad A = \frac{\text{S.I.}\times\text{T.D.}}{\text{S.I.}-\text{T.D.}}$$

**Illustration 4:** The true discount on a certain sum of money due for 2 years, hence it is ₹1800. The simple interest on the same sum is ₹2232. Find the sum.

**Solution:** Sum ($A$) $= \dfrac{\text{S.I.}\times\text{T.D.}}{\text{S.I.}-\text{T.D.}} = \dfrac{2232\times 1800}{2232-1800}$

$= \dfrac{2232\times 1800}{432}$ = ₹9300.

(iv) S.I. − T.D. = S.I. on T.D.

**Explanation**

$$\text{S.I.} - \text{T.D.} = \frac{A\times R\times T}{100} - \frac{\text{P.W.}\times R\times T}{100}$$

$$= (A - \text{P.W.}) \times \frac{R\times T}{100}$$

$$= \frac{\text{T.D.}\times R\times T}{100} = \text{S.I. on T.D.}$$

**Illustration 5:** The discount on a certain sum is due for 4 years, hence it is ₹100. But the interest on the same sum for the same period is ₹125. Find the sum and the interest rate.

**Solution:** We have,

S.I. on T.D. = S.I. − T.D.

= 125 − 100 = ₹25.

$\therefore$ Rate ($R$) $= \dfrac{25\times 100}{100\times 4} = \dfrac{25}{4} = 6\dfrac{1}{4}\%$

and, Sum ($A$) $= \dfrac{\text{S.I.}\times\text{T.D.}}{\text{S.I.}-\text{T.D.}} = \dfrac{125\times 100}{125-100}$

= ₹500.

(v) When the money is invested on compound interest,

$$\text{P.W.} = \frac{A}{\left(1+\dfrac{R}{100}\right)^T}$$

**Illustration 6:** Find the present worth of a bill of ₹3380 due for 2 years at 4% compound interest. Also, calculate the T.D.

**Solution:** $\text{P.W.} = \dfrac{A}{\left(1+\dfrac{R}{100}\right)^T} = \dfrac{3380}{\left(1+\dfrac{4}{100}\right)^2}$

$= \dfrac{3380\times 25\times 25}{26\times 26}$ = ₹3125.

T.D. = $A$ − P.W.

= 3380 − 3125 = ₹255.

2. B.D. = S.I. on the bill for unexpired time
3. B.G. = B.D. − T.D.
4. B.D. = T.D. + Interest on T.D.
5. Sum Due = $\dfrac{\text{B.D.} \times \text{T.D.}}{\text{B.D.} - \text{T.D.}}$
6. T.D. = $\sqrt{\text{P.W.} \times \text{B.G.}}$
7. T.D. = $\dfrac{\text{B.G.} \times 100}{\text{Rate} \times \text{Time}}$
8. T.D. = $\dfrac{\text{Amount} \times \text{Rate} \times \text{Time}}{100 + (\text{Rate} \times \text{Time})}$
9. B.D. = $\dfrac{\text{Amount} \times \text{Rate} \times \text{Time}}{100}$
10. Sum Due = $\dfrac{\text{B.D.} \times 100}{R \times T}$
11. Money paid by the banker = Amount − B.D.

**Illustration 7:** A bill is drawn for ₹5050 on June 12, 2004 for a 5 months credit period. It is discounted on September 3, at 5% per annum.

**Find the:**

(i) Banker's discount;

(ii) Money received by the holder of the bill; and

(iii) Banker's gain.

**Solution:** Amount = ₹5050.

Date of drawing = June 12, 2004 (for 5 months)

Date of maturing = Nov 15, 2004 (including 3 days grace)

Date of discounting = September 3, 2004.

Number of days from Sept 3. to Nov 15. =

| Sept. | Oct. | Nov. | |
|---|---|---|---|
| 27 | + 31 | + 15 | = 73 days = $\frac{1}{5}$ year. |

$\therefore$ (i) Banker's discount = $\dfrac{\text{Amount} \times \text{Rate} \times \text{Time}}{100}$

$= \dfrac{5050 \times 1 \times 5}{100 \times 5} =$ ₹50.50.

(ii) Amount received by the holder of the bill

= Amount − B.D.

= 5050 − 50.50 = ₹4999.50.

(iii) True discount on ₹5050

$= \dfrac{\text{Amount} \times \text{Rate} \times \text{Time}}{100 + (\text{Rate} \times \text{Time})}$

$= \dfrac{5050 + \frac{1}{5} \times 5}{100 + \frac{1}{5} \times 5} =$ ₹50

Banker's gain = B.D. − T.D. = ₹0.50.

**Illustration 8:** The banker's discount and the true discount on a certain sum of money due for 4 months are ₹48 and ₹45, respectively. Find the sum and the rate of interest.

**Solution:** Sum = $\dfrac{\text{B.D.} \times \text{T.D.}}{\text{B.D.} - \text{T.D.}} = \dfrac{48 \times 45}{48 - 45} = \dfrac{48 \times 45}{3}$

= ₹720.

Now, the banker's discount is simple interest on the sum due for 4 months.

Rate of interest = $\dfrac{100 \times 48 \times 3}{720 \times 1}$ = 20% p.a.

**Illustration 9:** Find the face value of a 3 months bill when the banker's discount at 3% per annum is ₹18.

**Solution:** B.D. = ₹18; Rate ($R$) = 3%,

Time ($T$) = $\frac{1}{4}$ years.

$\therefore$ Face value = $\dfrac{\text{B.D.} \times 100}{R \times T} = \dfrac{18 \times 100 \times 4}{3 \times 1} =$ ₹2400.

**Illustration 10:** The present worth of a bill due for sometime is ₹1500. Find the banker's discount on the bill, if the true discount is ₹75.

**Solution:** T.D. = $\sqrt{\text{P.W.} \times \text{B.G.}}$

$\Rightarrow$ 75 = $\sqrt{1500 \times \text{B.G.}}$

$\Rightarrow$ 75 × 75 = 1500 × B.G.

$\Rightarrow$ B.G. = $\dfrac{75 \times 75}{1500}$ = ₹ $\dfrac{15}{4}$

or, ₹3.75.

B.D. = T.D. + B.G. = 75 + 3.75 = ₹78.75.

**Illustration 11:** The banker's gain on a bill due for 1 year at 12% per annum is ₹6. Find the true discount.

**Solution:** T.D. = $\dfrac{\text{B.G.} \times 100}{R \times T} = \dfrac{6 \times 100}{12 \times 1} =$ ₹50.

**Illustration 12:** If the true discount on a certain sum due for 6 months at 6% is ₹36, what is the banker's discount on the same sum for the same period and at the same rate?

**Solution:** B.D. = T.D. + Interest on T.D.

= T.D. + $\dfrac{\text{T.D.} \times R \times T}{100} = 36 + \dfrac{36 \times 6 \times 6}{100 \times 12}$

= 36 + 1.08 = ₹37.08.

## EXERCISE-I

1. The true discount on a bill of ₹1260 is due for 6 months at 10% per annum is:
(a) ₹60 (b) ₹160
(c) ₹80 (d) ₹260

2. If the discount on a certain sum in 2 years at a certain rate is ₹150 and the interest in 3 years is ₹240. Find the sum and the rate of interest.
(a) ₹2400, $3\frac{1}{3}\%$ (b) ₹2400, $4\frac{1}{3}\%$
(c) ₹2200, $5\frac{1}{3}\%$ (d) None of these

3. If the true discount on ₹161 is due for 2 years and 6 months is ₹21, then find the rate of interest.
(a) $2\frac{1}{2}\%$ (b) $4\frac{1}{2}\%$
(c) 5% (d) 6%

4. The present worth of ₹920 due at the end of 3 years at 5% simple interest per annum is:
(a) ₹780 (b) ₹850
(c) ₹800 (d) ₹810

5. If the simple interest on a certain sum is due for some years at 6% is ₹180, and the discount at 5% on the same amount is ₹140. Find the sum and the time.
(a) ₹2100 and $1\frac{3}{7}$ years
(b) ₹2200 and $2\frac{3}{7}$ years
(c) ₹2000 and $2\frac{3}{7}$ years
(d) None of these

6. The banker's gain on a certain sum of money is due for 9 months at 4% p.a. is ₹2.25. The sum is:
(a) ₹2575 (b) ₹2500
(c) ₹2250 (d) ₹3250

7. At a given rate, the simple interest and the true discount on a certain sum, for a given time, are ₹24 and ₹22, respectively. The sum is:
(a) ₹264 (b) ₹220
(c) ₹288 (d) ₹295

8. The present worth of a bill of ₹1764 due for 2 years at 5% compound interest is:
(a) ₹1650 (b) ₹1700
(c) ₹1600 (d) ₹1714

9. If ₹21 is the true discount on ₹371 for a certain time, what is the true discount on the same amount for double that time, the rate being the same in both the cases?
(a) ₹39.00 (b) ₹35.75
(c) ₹40.00 (d) ₹39.75

10. The T.D. on a certain sum of money due in 2 years is ₹1800 and the simple interest on the same amount is ₹2232. Find the sum.
(a) ₹9300 (b) ₹9350
(c) ₹9450 (d) ₹9400

11. The present worth of ₹220.50 due in 2 years reckoning compound interest at 5% is:
(a) ₹200 (b) ₹197.5
(c) ₹202 (d) ₹192.25

12. The T.D. on ₹936 is due after a certain time at 8% is ₹36. The money is due after:
(a) 6 months (b) 3 months
(c) 1 year (d) 9 months

13. A man bought a motor-cycle for ₹32500. He sold it for ₹35000, allowing the buyer for a 6 months credit. If the money be worth 4% per annum, the gain per cent is:
(a) $8\frac{1}{7}\%$ (b) $7\frac{9}{13}\%$
(c) $7\frac{5}{13}\%$ (d) $8\frac{2}{5}\%$

14. Find the present worth of a bill of ₹3720 which is due for 2 years at 12% compound interest, being compounded annually.
(a) ₹3100 (b) ₹3150
(c) ₹3125 (d) ₹3225

15. The holder of a bill for ₹17850 nominally due on May 21, 1991 received ₹357 less than the amount of the bill by having it discounted at 5%. When was it doscounted?
(a) Dec 29, 1990 (b) Dec 30, 1989
(c) Dec 19, 1990 (d) None of these

16. The true discount on a certain bill due for nine months at 4% simple interest is ₹150. Find the amount of the bill.
(a) ₹5150 (b) ₹5250
(c) ₹4750 (d) ₹5650

**17.** A banker discounts a 4 months bill at 3%. If the proceeds be invested in a manner, so that nothing is lost, the interest rate should be:

(a) 3% (b) 4%

(c) $3\frac{1}{33}\%$ (d) None of these

**18.** The difference between the simple interest and the true discount on a certain sum of money for 2 years at 15% per annum at simple interest is ₹45. Find the sum.

(a) ₹700 (b) ₹650
(c) ₹675 (d) ₹625

**19.** The present worth of a sum of money due for 146 days at 5% is ₹400. The sum due is:

(a) ₹410 (b) ₹408
(c) ₹415 (d) ₹450

**20.** The present worth of a bill due in sometime is ₹1500. Find the banker's discount on the bill, if the true discount is ₹75.

(a) ₹78.75 (b) ₹77.75
(c) ₹82.75 (d) ₹76.75

**21.** If the simple interest on ₹2000 at 5% p.a. is equal to the true discount on ₹2500 for the same time and at the same rate, the time is:

(a) $4\frac{1}{2}$ years (b) 5 years

(c) $7\frac{1}{2}$ years (d) $2\frac{1}{2}$ years

**22.** ₹21 is the true discount on ₹371 for a certain time at certain int. If the rate of interest is kept same, true discount on the same sum for double that time will be:

(a) ₹44.38 (b) ₹39.75
(c) ₹33.25 (d) None of these

**23.** The true discount on a bill of ₹5450 due in 9 months is ₹450. Find the rate of interest.

(a) 12% (b) 12.5%
(c) 11.5% (d) 13.1%

**24.** If ₹10 be allowed as true discount on a bill of ₹110 due at the end of certain time, then the discount allowed on the same amount due at the end of double the time is:

(a) ₹20 (b) ₹21.81
(c) ₹22 (d) ₹18.33

**25.** A bill which being due at the end of 4 years is now worth ₹575, but if it is due in $2\frac{1}{2}$ years, it would now be worth ₹620. The sum of the bill is:

(a) ₹695 (b) ₹725
(c) ₹713 (d) None of these

**26.** Find the present worth (P.W.) and the true discount reckoning 6% per annum simple interest of ₹176 due in 20 months time.

(a) ₹160, ₹16 (b) ₹130, ₹46
(c) ₹150, ₹26 (d) None of these

**27.** What rate of interest does a man get for his money when in discounting a bill due in 10 months, he deducts 4% of the amount of the bill?

(a) 5% (b) 6%
(c) 8% (d) 4%

**28.** The discount on ₹5229 due in 1 year 9 months reckoning compound interest at 5% is:

(a) ₹429.00 (b) ₹415.00
(c) ₹393.25 (d) None of these

**29.** A bill is discounted at 5% per annum. If banker's discount be allowed, at what rate of interest must the proceeds be invested, so that nothing is lost?

(a) 5% (b) $4\frac{19}{20}\%$

(c) $5\frac{5}{19}\%$ (d) 10%

**30.** If the compound interest on a certain sum of money for 2 years at 4% is ₹45.90, the true discount on the same amount of money due 2 years at 4% simple interest is:

(a) ₹39.69 (b) ₹41.67
(c) ₹45.00 (d) ₹38.45

**31.** The true discount on a bill of ₹2550 due after 3 months is ₹50. Find the banker's discount.

(a) ₹53 (b) ₹51
(c) ₹55 (d) ₹57

**32.** A owes B ₹1350 due in 3 months and B owes A ₹1078 due 5 months. If they agrees to settle their account right now at 5% p.a., A should pay to B:

(a) ₹$277\frac{1}{3}$ (b) ₹288.25

(c) ₹302 (d) None of these

**33.** ₹20 is the true discount on ₹260 due after a certain time. What will be the true discount on the same amount due after half of the earlier time, the rate of interest being the same.

(a) ₹10 (b) ₹10.40
(c) ₹15.20 (d) ₹13

**34.** What is the rate of interest when the P.W. of ₹1245 due in 15 months is ₹1200?

(a) 3% (b) 4%

(c) $4\frac{1}{2}\%$ (d) 5%

**35.** A has to pay ₹22 to B after 1 year. B asks A to pay ₹110 in cash and defers the payment of ₹110 for 2 years. A agrees to it. Counting the rate of interest at 10% per annum in this new mode of payment,

(a) there is no gain or loss to anyone.
(b) A gains ₹7.34
(c) A loses ₹7.34
(d) A gains ₹11

**36.** The B.G. on a sum due 3 years at 10% is ₹180. The B.D. is:

(a) ₹680 (b) ₹780
(c) ₹580 (d) ₹480

**37.** If the discount on ₹249 at 5% S.I. be ₹9, when is the sum due?

(a) 6 months (b) 4 months
(c) 9 months (d) 7 months

**38.** The banker's gain on a certain sum due in 2 years at 5% per annum is ₹8. The present worth is:

(a) ₹800 (b) ₹1600
(c) ₹1200 (d) ₹880

**39.** The B.G. on a certain sum due in 5 years is $\frac{3}{23}$ of B.D. Here, the rate of interest is:

(a) 6% (b) 5%
(c) 4% (d) 3%

## Exercise-2
## (Based on Memory)

**1.** A fan is listed at ₹1500 and a discount of 20% is offered on the list price. What additional discount must be offered to the customer to bring the net price to ₹1104?

(a) 8% (b) 10%
(c) 12% (d) 15%

**[SSC (GL) Prel. Examination, 2005]**

**2.** A company offers three types of successive discounts: (i) 25% and 15%, (ii) 30% and 10%, (iii) 35% and 5%. Which offer is the best for a customer?

(a) First offer
(b) Second offer
(c) Third offer
(d) Any one; all are equally good

**[SSC (GL) Prel. Examination, 2007]**

**3.** A man buys a single apple for ₹25. If he were to buy a dozen apples, he would have to pay a total amount of ₹250. What would be the approximate per cent discount he would get on buying a dozen apples?

(a) 32 (b) 20
(c) 12 (d) 17

**[Bank of India PO, 2010]**

**4.** An article is marked 40% above the cost price and a discount of 30% is allowed. What is the gain or loss percentage?

(a) 10% gain (b) 5% gain
(c) 2% loss (d) 12% loss

**[SSC (GL), 2011]**

**5.** The difference between a discount of 40% on ₹500 and two successive discounts of 36%, 4% on the same amount is:

(a) ₹0 (b) ₹2
(c) ₹1.93 (d) ₹7.20

**[SSC (GL), 2011]**

**6.** If on a marked price, the difference of selling prices with a discount of 30% and two successive discounts of 20% and 10% is ₹72, then the marked price (in rupees) is:

(a) 3,600 (b) 3,000
(c) 2,500 (d) 2,400

**[SSC (GL), 2010]**

**7.** Successive discounts of 10%, 20% and 30% is equivalent to a single discount of:

(a) 60% (b) 49.6%
(c) 40.5% (d) 36%

**[SSC (GL), 2010]**

**8.** Two successive discounts of $a\%$ and $b\%$ on the marked price of an article are equivalent to the single discount of:

(a) $(a + b)\%$ (b) $\left(a+b-\frac{ab}{100}\right)\%$

(c) $\frac{a+b}{100}\%$ (d) $\frac{a+b}{2}\%$

**[SSC, 2013]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (a) | **3.** (d) | **4.** (c) | **5.** (a) | **6.** (a) | **7.** (a) | **8.** (c) | **9.** (d) | **10.** (a) | **11.** (a) | **12.** (a) | **13.** (b) |
| **14.** (c) | **15.** (a) | **16.** (a) | **17.** (c) | **18.** (b) | **19.** (b) | **20.** (a) | **21.** (b) | **22.** (b) | **23.** (a) | **24.** (d) | **25.** (c) | **26.** (a) |
| **27.** (a) | **28.** (a) | **29.** (c) | **30.** (b) | **31.** (b) | **32.** (a) | **33.** (b) | **34.** (a) | **35.** (b) | **36.** (b) | **37.** (c) | **38.** (a) | **39.** (d) |

### Exercise-2

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (c) | **3.** (d) | **4.** (c) | **5.** (d) | **6.** (a) | **7.** (b) | **8.** (b) |

## EXPLANATORY ANSWERS

### Exercise-1

**1. (a)** T.D. = ₹ $\dfrac{1260\times\frac{1}{2}\times10}{100+\frac{1}{2}\times10}$ = ₹60.

**2. (a)** Interest for 2 years = $\dfrac{240\times2}{3}$ = ₹160

Discount for 2 years = ₹150

Sum due = $\dfrac{\text{B.D.}\times\text{T.D.}}{\text{B.D.}-\text{T.D.}}=\dfrac{160\times150}{160-150}$ = ₹2400

Rate of interest = $\dfrac{240\times100}{2400\times3}=3\dfrac{1}{3}\%$.

**3. (d)** ₹21 is the interest on ₹(161 − 21)

or, ₹140 for 2 years 6 months

∴ Rate % = $\dfrac{21\times100}{140\times5/2}$ = 6%.

**4. (c)** Present worth = $\dfrac{A\,\text{Ÿ}\,100}{100+R\times T}$ = ₹ $\dfrac{920\times100}{100+3\times5}$

= ₹ $\dfrac{920\times100}{115}$ = ₹800.

**5. (a)** B.D. or Simple Interest at 5%

= $\dfrac{180\times5}{6}$ = ₹150

Discount at 5% = ₹140

Sum = $\dfrac{\text{B.D}\times\text{T.D.}}{\text{B.D.}-\text{T.D.}}=\dfrac{150\times140}{150-140}$ = ₹2100.

Rate per cent = $\dfrac{180\times100}{2100\times6}=1\dfrac{3}{7}$ years.

**6. (a)** B.G. is the interest on T.D.

∴ T.D. = $\dfrac{2.25\times100}{\frac{3}{4}\times4}$ = ₹75

B.D. = ₹75 + ₹2.25 = ₹77.25

∴ Sum due = $\dfrac{\text{B.D.}\times\text{T.D.}}{\text{B.G.}}$ = ₹ $\dfrac{77.25\times75}{2.25}$

= ₹2575.

**7. (a)** Sum = $\dfrac{\text{T.D.}\times\text{S.I.}}{\text{S.I.}-\text{T.D.}}=\dfrac{24\times22}{24-22}$ = ₹264.

**8. (c)** P.W. = ₹1764 ÷ $\left(1+\dfrac{5}{100}\right)^2$

= ₹1764 × $\dfrac{400}{441}$ = ₹1600.

**9. (d)** ₹21 is the interest on ₹(371 − 21) = ₹350

∴ $\dfrac{350\times\text{no. of years}\times\text{rate}}{100}$ = 21

⇒ Number of years × rate = $\dfrac{2100}{350}$ = 6

∴ Twice number of years × rate = 12

Now, on ₹112, the T.D. is ₹12

∴ on ₹371, the T.D. = ₹ $\dfrac{12}{112}$ × 371

= ₹39.75.

**10. (a)** Sum = $\dfrac{\text{Simple interest on the sum}\times(\text{T.D.})}{\text{Simple interest on the sum}-(\text{T.D.})}$

= ₹ $\left(\dfrac{2232\times1800}{2232-1800}\right)$

= ₹ $\left(\dfrac{2232\times1800}{432}\right)$

= ₹9300.

**11. (a)** P.W. = $\dfrac{220.5}{\left(1+\dfrac{5}{100}\right)^2}=\dfrac{220.5\times20\times20}{21\times21}$

= ₹200.

**12.** **(a)** P.W. = ₹(936 − 36) = ₹900

₹36 is S.I. on ₹900

$\therefore$ Time $= \frac{36 \times 100}{900 \times 8} = \frac{1}{2}$ year

= 6 months.

**13.** **(b)** S.P. of motor = cycle = ₹35000

Gain = ₹35000 − ₹32500

= ₹2500

$\therefore$ Gain % $= \frac{2500}{32500} \times 100\%$

$= \frac{100}{13}\% = 7\frac{9}{13}\%$.

**14.** **(c)** P.W. $= \frac{A}{\left(1+\frac{R}{100}\right)^T} = ₹\frac{3720}{\left[1+\frac{12}{100}\right]^2}$

$= ₹3720 \times \frac{25}{28} \times \frac{25}{28} = ₹3125$.

**15.** **(a)** Clearly, S.I. on ₹17850 at 5% is ₹357.

$\therefore$ Time $= \left(\frac{100 \times 357}{17850 \times 5}\right) = \frac{2}{5}$ years = 146 days.

So, the bill is 146 days prior to May 24, the legally due date.

| May | April | March | Feb. | Jan. | Dec. | |
|---|---|---|---|---|---|---|
| 24 | +30 | +31 | +28 | +31 | +2 | = 146 days |

So, the bill was discounted on Dec 29, 1990.

**16.** **(a)** P.W. = T.D. $\times \frac{100}{R \times T} = ₹\frac{150 \times 100}{\frac{9}{12} \times 4}$

= ₹5,000

$\therefore$ Amount of the bill = ₹5000 + ₹150

= ₹5150.

**17.** **(c)** 4 months $= \frac{1}{3}$ year

$\therefore$ Banker deducts ₹3 × $\frac{1}{3}$ = ₹1 from a bill of ₹100.

So, the banker pays ₹(100 − 1) = ₹99.

So, the bill-holder loses ₹1.

So, for investment ₹1 should be interest on ₹99 for 4 months.

$\therefore$ Rate of Interest $= \frac{1 \times 100}{99 \times \frac{4}{12}} = \frac{100}{33} = 3\frac{1}{33}\%$

**18.** **(b)** Let the sum be ₹100.

Time = 2 years

Rate = 15% per annum

S.I. $= ₹\left(\frac{100 \times 15 \times 2}{100}\right)$ = ₹30

Time Discount $= ₹\left[\frac{100 \times R \times T}{100 + (R \times T)}\right]$

$= ₹\left[\frac{100 \times 15 \times 2}{100 + (15 \times 2)}\right]$

$= ₹\left[\frac{100 \times 15 \times 2}{130}\right] = ₹\frac{300}{13}$.

The difference between S.I. and T.D. is

$₹\left(30 - \frac{300}{13}\right) = ₹\frac{90}{13}$

If the difference in S.I. and T.D. is $₹\frac{90}{13}$, the sum = ₹100.

If the difference in S.I. and T.D. is ₹1,

The sum = ₹100 × $\frac{13}{10}$.

If the difference in S.I. and T.D. is ₹45,

the sum = ₹100 × $\frac{13}{90}$ × 45 = ₹650.

**19.** **(b)** T.D. = ₹400 × $\frac{146}{365} \times \frac{5}{100}$ = ₹8

S.D. = ₹400 + ₹8 = ₹408.

**20.** **(a)** T.D. $= \sqrt{\text{P.W.} \times \text{B.G.}}$

$75 = \sqrt{1500 \times \text{B.G.}}$

Squaring both the sides,

75 × 75 = 1500 × B.G.

B.G. $= ₹\frac{75 \times 75}{1500} = ₹\frac{15}{4}$ = ₹3.75

B.D. = T.D. + B.G.

= 75 + ₹3.75 = ₹78.75.

**21.** **(b)** T.D. = ₹500

Rate = 5%

P.W. = ₹2000

$\therefore$ Time $= \frac{500 \times 100}{2000 \times 5}$ = 5 years.

**22.** **(b)** P.W. of ₹371 = ₹(371 − 21) = ₹350

Also, T.D. = Simple Interest on P.W.

$\therefore$ Simple Interest on ₹350 for a certain period at certain rate p.c. = ₹21.

$\therefore$ Simple Interest on ₹350 for double the period at same rate p.c. = ₹42.

$\therefore$ ₹42 is T.D. on ₹(350 + 42) = ₹392 for double the period.

$\therefore$ T.D. on ₹371 for double the period and same rate p.c.

$= \frac{42}{392} \times 371$ = ₹39.75.

**23.** **(a)** Amount = ₹5450

P.W. = Amount − T.D.

$= ₹5450 - ₹450$

$= ₹5000$

In other words, simple interest on ₹5000 for 9 months is ₹450

$\therefore$ Rate $= \dfrac{\text{S.I.} \times 100}{P \times T} = \dfrac{450 \times 100 \times 4}{5000 \times 3}$

$= 12\%$ per annum.

**24. (d)** S.I. on ₹(110 − 10) for a given time = ₹10

S.I. on ₹100 for double the time = ₹20

Sum = ₹(100 + 20) = ₹120

T.D. on ₹110 $= ₹\left(\dfrac{20}{120} \times 110\right) = ₹18.33.$

**25. (c)** Let, the rate p.c. be $r$ %.

Let, ₹$x$ be the amount of the bill.

Then, $575 = \dfrac{x \times 100}{100 + 4r}$

That is, $57500 + 2300r = 100x$

$\therefore\ x = 575 + 23r \qquad \cdots(1)$

and, $620 = \dfrac{100x}{100 + \frac{5}{2}r}$

$\therefore\ 62000 + 1550r = 100x$

$\therefore\ 6200 + 155r = 10x$

$= 5750 + 230r$ [using (1)]

$\therefore\ 75r = 450$

$\therefore\ r = 6$

$\therefore$ (1) $\Rightarrow x = 575 + 138 = ₹713.$

**26. (a)** Present Worth $= \dfrac{100 \times 76}{100 + 6 \times \frac{20}{12}} = ₹160$

True discount = Amount − Present worth

$= ₹176 - ₹160$

$= ₹16.$

**27. (a)** Let the amount of the bill be ₹100.

Money deducted = ₹4

Money received by holder of the bill

$= ₹(100 - 4) = ₹96$

S.I. on ₹96 for 10 months = ₹4

Rate $= \dfrac{100 \times 4 \times 6}{96 \times 5} = 5\%.$

**28. (a)** P.W. $= \dfrac{5229}{\left(1 + \frac{5}{100}\right)\left(1 + \frac{3}{4} \cdot \frac{5}{100}\right)}$

$= 5229 \times \dfrac{20}{21} \times \dfrac{80}{83} = ₹4800$

$\therefore$ T.D. = ₹(5229 − 4800) = ₹429.

**29. (c)** Let the sum be ₹100. Then, B.D. = ₹5

Proceeds = ₹(100 − 5) = ₹95

$\therefore$ ₹5 must be the interest on ₹95 for 1 year.

So, rate $= \left(\dfrac{100 \times 5}{95 \times 1}\right) = 5\dfrac{5}{19}\%.$

**30. (b)** Let the sum be ₹$x$. Then,

$45.90 = x\left\{\left(1 + \dfrac{4}{100}\right)^2 - 1\right\}$

$= \left\{\left(\dfrac{26}{25}\right)^2 - 1\right\} = \left\{\dfrac{676 - 625}{625}\right\}$

$\therefore\ x = \dfrac{625 \times 45.9}{51} = ₹562.5$

$\therefore$ T.D. on ₹562.5

$= \dfrac{562.5 \times 4 \times 2}{100 + 4 \times 2} = \dfrac{4500}{108} = ₹41.67.$

**31. (b)** T.D. = ₹50

P.W. = ₹2550 − ₹50 = ₹2500

Rate of Interest $= \dfrac{50 \times 100 \times 4}{2500 \times 1} = 8\%$ per annum

B.D. $= ₹\left[\dfrac{2550}{100} \times 8 \times \dfrac{1}{4}\right] = ₹51.$

**32. (a)** P.W. of ₹1350

$= \dfrac{1350 \times 100}{100 + \frac{3}{12} \times 5} = \dfrac{1350 \times 400}{405}$

$= ₹\dfrac{4000}{3}$

P.W. of ₹1078 $= \dfrac{1078 \times 100}{100 + \frac{5}{12} \times 5} = \dfrac{1078 \times 1200}{1225}$

$= ₹1056$

$\therefore$ A should pay B $= ₹\left(\dfrac{4000}{3} - 1056\right)$

$= ₹\dfrac{832}{3} = ₹277\dfrac{1}{3}.$

**33. (b)** S.I. on ₹240 for a given time = ₹20

S.I. on ₹240 for half the time = ₹10

$\therefore$ ₹10 is T.D. on ₹250

So, T.D. on ₹260 $= ₹\left(\dfrac{10}{250} \times 260\right) = ₹10.40.$

**34. (a)** T.D. = ₹1245 − ₹1200 = ₹45

P.W. = ₹1200

$\therefore$ Rate of interest $= \dfrac{45 \times 100}{1200 \times 15/12} = 3\%.$

**35. (b)** A has to pay the P.W. of ₹220 due 1 year hence, which is

$= ₹\left[\dfrac{100 \times 220}{100 + (10 \times 1)}\right] = ₹200$

A actually pays = ₹[110 + P.W. of ₹110 due 2 years].

$$= ₹\left[110+\frac{100\times110}{100+(8\times2)}\right]$$

= ₹192.66

∴ A gains = ₹[200 − 192.66] = ₹7.34.

**36.** **(b)** $\text{T.D.} = \frac{\text{B.G.}\times100}{R\times T} = ₹\frac{180\times100}{10\times3} = ₹600$

∴ B.D. = ₹(600 + 180) = ₹780.

**37.** **(c)** P.W. = ₹249 − ₹9 = ₹240

T.D. = ₹9

Rate = 5%

$$\therefore \text{ Time} = \frac{\text{T.D.}\times100}{\text{P.W.}\times\text{rate}} = \frac{9\times100}{240\times5} = \frac{3}{4}\text{ year}$$

= 9 months.

**38.** **(a)** $\text{T.D.} = \frac{\text{B.G.}\times100}{\text{Rate}\times\text{Time}} = ₹\left(\frac{8\times100}{5\times2}\right)$

= ₹800.

**39.** **(d)** Let, B.D. = ₹1

$$\because \text{ B.G.} = ₹\frac{3}{23}$$

$$\therefore \text{ T.D.} = ₹\left[1-\frac{3}{23}\right] = ₹\frac{20}{23}$$

$$\therefore \text{ Sum} = \frac{\text{B.D}\times\text{T.D.}}{\text{B.D}-\text{T.D.}} = \frac{1\times\frac{20}{23}}{1-\frac{20}{23}} = ₹\frac{20}{3}$$

∵ S.I. on $₹\frac{20}{3}$ for 5 years is ₹1.

$$\therefore \text{ Rate of interest} = \frac{100\times3}{20\times5} = 3\%.$$

## Exercise-2
## (Based on Memory)

**1.** **(a)** M.P. = ₹1500

Discount = 20%

∴ S.P. = ₹1200

Let, 1200 − $x$% of 1200 = ₹1104

⇒ $x$% of 1200 = 96 ⇒ $x = 8$

∴ An additional discount of 8% must be offered to the customer to bring the net price to ₹1104.

**3.** **(d)** Cost of one apple = ₹25

∴ Cost of 12 apples = 25 × 12 = ₹300

Amount paid = ₹250

Discount = 300 − 250 = ₹50

$$\%\text{ Discount} = \frac{50\times100}{300}$$

= 17% (approx.)

**4.** **(c)** Let the C.P. of the article be ₹100. Therefore, marked price = ₹140

S.P. = 70% of 140 = ₹98

$$\text{loss\%} = \frac{100-98}{100}\times100 = 2\%$$

**5.** **(d)** Single equivalent discount for 36% and 4%

$$= \left(\frac{36+4-36\times4}{100}\right)$$

= (40 − 1.44)% = 38.56%

Therefore, required difference

= 1.44% of 500

$$= \frac{1.44}{100}\times500 = ₹7.20$$

**6.** **(a)** Let the marked price be ₹$x$

Therefore, in case 1, S.P.

$$= ₹\frac{70x}{100}$$

Single discount equivalent to successive discounts of 20% and 10%.

$$= \left(\frac{20+10-20\times10}{100}\right)\%$$

$$\text{Ex} = \left(\frac{30-200}{100}\right)\%$$

= (30 − 2)%

= 28%

Hence S.P. in this case

$$= ₹\frac{72x}{100}$$

Therefore,

$$₹\frac{72x}{100}-\frac{70x}{100} = ₹72$$

$$\Rightarrow \frac{2x}{100} = 72$$

$$\Rightarrow 2x = 7200$$

$$\Rightarrow x = \frac{7200}{2}$$

= ₹3600

**7.** **(b)** Single equivalent discount for successive discounts of 10% and 20%

$$= \left(10 + 20 - \frac{20 \times 100}{100}\right)\%$$

$$= 28\%$$

Single equivalent discount for 28% and 30%

$$= \left(28 + 30 - \frac{28 \times 30}{100}\right)$$

$$= 49.6\%$$

**8.** **(b)** Let the Marked price of the article be ₹100.

First discount = ₹$a$.

Second discount $= 100 - a \times \frac{b}{100} = b - \frac{ab}{100}$

$\therefore$ Total discount percent $= \left(a + b - \frac{ab}{100}\right)\%$

# Binary Number System

# 22

## INTRODUCTION

A number system is nothing more than a code. For each distinct quantity there is an assigned symbol. The most familiar number system is the decimal system which uses 10 digits, that is, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. The main advantage of this system is its simplicity and long use. Most of the ancient societies used this system. Even in our everyday life we use this system and is sometimes being taken as the natural way to count. Since this system uses 10 digits it is called a system to base 10.

A *binary number system* is a code that uses only two basic symbols, that is, 0 and 1. This system is very useful in computers. Since, in this system, only two symbols are there, it can be used in electronic industry using 'on' and 'off' positions of a switch denoted by the two digits 0 and 1.

### Decimal Number System

Decimal number system used 10 digits, 0 through 9, that is, the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

### Binary Number System

Binary means two. The binary number system uses only two digits, i.e., 0 and 1.

### Base or Radix

The *base* or *radix* of a number system is equal to the number of digits or symbols used in that number system. For example, decimal system uses 10 digits, so that base of decimal system (that is, decimal numbers) is 10. Binary numbers have base 2.

A subscript attached to a number indicates the base of the number. For example, $100_2$ means binary 100. $100_{10}$ stands for decimal 100.

### Weights

In any number to a given base, each digit, depending on its position in the number has a weight in powers of the base.

**Illustration 1:** In the number $(5342)_x$.
The weight of 2 is $x^0$
The weight of 4 is $x^1$
The weight of 3 is $x^2$
The weight of 5 is $x^3$.

The sum of all the digits multiplied by their respective weights is equal to the decimal equivalent of that number and gives the total amount represented by that number.

$$(5342)_x = (5x^3 + 3x^2 + 4x + 2x^0)_{10}$$

**Illustration 2:**

| 5 | 7 | 0 | 3 | 4 | Number to the base 10, |
|---|---|---|---|---|---|
| $10^4$ | $10^3$ | $10^2$ | $10^1$ | $10^0$ | that is, decimal number weights |

$\therefore \quad 5 \times 10^4 + 7 \times 10^3 + 0 \times 10^2 + 3 \times 10 + 4 \times 10^0$
= Value represented or decimal equivalent

**Illustration 3:**

| 1 | 1 | 0 | 0 | 1 | Number to the base 2 |
|---|---|---|---|---|---|
| $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ | that is, binary number weights |

$\therefore \quad 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$
$= 16 + 8 + 1 = 25$
= Decimal equivalent or value represented by $11001_2$.

**Decimal to Binary Conversion**

**Step 1** Divide the number by 2.

**Step 2** Divide Quotient of Step 1 by 2

Continue the process till we get quotient = 0 and remainder as 1.

Then, the remainders from down upwards written from left to right give the binary number.

**Illustration 4:** Convert decimal 23 to binary.

**Solution:**

| | | Remainders |
|---|---|---|
| 2 | 23 | |
| 2 | 11 | 1 |
| 2 | 5 | 1 |
| 2 | 2 | 1 |
| | 1 | 0 |
| | 0 | 1 |

Reading the remainders upwards and writing from left to right we get the binary equivalent of decimal 23 as 10111.

That is, Binary 10111 is equivalent to decimal 23 or we can write $10111_2 = 23_{10}$.

**Binary to Decimal Conversion**

Following steps are involved to convert a binary number to its decimal equivalent

**Step 1** Write the binary number.

**Step 2** Write the weights $2^0, 2^1, 2^2, 2^3$, ... under the binary digits starting from extreme right.

**Step 3** Cross out any weight under a zero, that is, weights under zeros in the binary number should be deleted.

**Step 4** Add the remaining weights.

**Illustration 5:** Convert binary 1101 to its decimal equivalent.

**Solution:**

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 0 | 1 | Binary number |
| $2^3$ | $2^2$ | $2^1$ | $2^0$ | weights |

The weight $2^1$ is under 0 so it can be deleted. Sum of the remaining weights

$= 2^3 + 2^2 + 2^0 = 8 + 4 = 1 = 13.$

∴ Decimal equivalent of binary 1101 = 13, that is, $1101_2 = 13_{10}$.

## Binary Addition

In binary number system there are only 2 digits, that is, 0 and 1. In decimal system we carry 1 for every 10 whereas in binary system we carry 1 for every 2. Hence, rules of addition are as under:

$$0 + 0 = 0$$
$$0 + 1 = 1$$
$$1 + 0 = 1$$
$$1 + 1 = 10$$

**Illustration 6:** Add 1010 to 10100

**Solution:**

$$\begin{array}{r} 10100 \\ +1010 \\ \hline 11110 \end{array}$$

## Binary Subtraction

1. 0 – 0 = 0
2. 1 – 0 = 1
3. 1 – 1 = 0
4. 10 – 1 = 1
5. 0 – 1 = –1

[Complement of a binary number is the exact reverse of the given number]

Complement of 0 = 1

Complement of 1 = 0

For subtraction of binary number the following method known as one's complement method is used.

**Subtraction of a Lower Number from a Higher Number**

To determine which binary number is lower and which is higher, it is advisable to find their decimal equivalents.

**Step 1** Make the number of digits equal in both the numbers.

**Step 2** Take the complement of the second number, that is, take the complement of the number to be subtracted.

**Step 3** Add the complement obtained in Step II to the first number. The carry over obtained from this addition indicates that the answer shall be positive.

**Step 4** This carry over is taken out and added to the first digit on the right, that is, extreme right digit.

**Step 5:** The digits so obtained is the final answer.

**Illustration 7:** Subtract 11 from 101.

**Solution:** Now, $101_2 = 4 + 1 = 5_{10}$, $11_2 = 2 + 1 = 3_{10}$. Clearly, 11 is smaller than 101. Making the number of digits equal, we write 11 as 011.

Complement of 011 = 100.

Adding 100 to 101, we get

$$\begin{array}{rr} & 101 \\ & 100 \\ \hline (1) & 001 \end{array} \qquad \text{[Carry over is 1]}$$

Taking out the carry over and adding to extreme right digit, we get

$$\begin{array}{r} 001 \\ 1 \\ \hline 010 \end{array}$$

∴ The answer is 010 or 10.

**Subtraction of a Higher Number from a Lower Number.**

**Step 1** Take the complement of the second number.

**Step 2** Add the complement obtained in Step I to the first number. In this case there is no carry over indicating that the answer is negative.

**Step 3** Recomplement the digits obtained after adding the complement of the second number to the first number.

**Step 4** Put a negative sign before the result obtained in Step 4.

**Illustration 8:** Subtract 1110 from 1001.

**Solution:** Now, $1110_2 = 8 + 4 + 2 = 14_{10}$;

$1001 = 8 + 2 = 10_{10}$.

Clearly, $1110_2 > 1001_2$.

Complement of 1110 = 0001.

Adding 0001 to 1001, we get

$$\begin{array}{r} 1001 \\ \underline{0001} \\ 1010 \end{array}$$

[There is no carry over]

Complement of 1010 = 0101.

∴ The answer is –0101 or – 101.

### Binary Multiplication

Rules: 1 × 1 = 1, 1 × 0 = 0.

**Illustration 9:** Multiply 1111 by 11.

**Solution:**

$$\begin{array}{r} 1111 \\ \underline{11} \\ 1111 \\ \underline{1111\phantom{0}} \\ \underline{101101} \end{array}$$

## EXERCISE-1

**1.** Find the binary equivalent of decimal 117.
(a) 1010101 (b) 1110101
(c) 1111101 (d) None of these

**2.** Find the binary equivalent of decimal 52.
(a) 110100 (b) 111100
(c) Remainder (d) None of these

**3.** Find the decimal equivalent of binary 1110101.
(a) $110_{10}$ (b) $111_{10}$
(c) $117_{10}$ (d) None of these

**4.** Find the binary equivalent of decimal 235.
(a) $1010111_2$ (b) $1010111_2$
(c) $11101011_2$ (d) None of these

**5.** Find the binary equivalent of decimal 701.
(a) $1010111101_2$ (b) $1011101101_2$
(c) $1110111101_2$ (d) None of these

**6.** Find the decimal equivalent of binary 101001.
(a) 31 (b) 41
(c) 51 (d) None of these

**7.** Find the decimal equivalent of binary 10000010011.
(a) 1043 (b) 1023
(c) 1033 (d)

**8.** Find the decimal equivalent of binary 111011.
(a) 69 (b) 49
(c) 59 (d) None of these

**9.** Add 1001 to 0101.
(a) 1111 (b) 1110
(c) 1010 (d) None of these

**10.** Add 11010 to 11100.
(a) 110110 (b) 111110
(c) 110111 (d) None of these

**11.** $11111_2 + 10001_2 + 1011_2 =$
(a) 110111 (b) 111001
(c) 111011 (d) None of these

**12.** $11001_2 + 11011_2 + 11111_2 =$
(a) 1010011 (b) 111011
(c) 1110011 (d) None of these

**13.** $11_2 + 111_2 + 1111_2 + 11111_2 =$
(a) 101010 (b) 111000
(c) 101100 (d) None of these

**14.** $111_2 + 101_2 =$
(a) 1111 (b) 10111
(c) 1100 (d) None of these

**15.** $1000_2 + 1101_2 + 1111_2 =$
(a) 100100 (b) 111100
(c) 101010 (d) None of these

**16.** $111_2 + 101_2 + 011_2 =$
(a) 1011 (b) 1111
(c) 1101 (d) None of these

**17.** $111000_2 - 11001_2 =$
(a) 11111 (b) 10111
(c) 11011 (d) None of these

**18.** $10001_2 - 1111_2 =$
(a) 101 (b) 11
(c) 10 (d) None of these

**19.** $111101_2 - 10111_2 =$

(a) 111110 (b) 100110
(c) 101110 (d) None of these

**20.** $11111_2 - 10001_2 =$

(a) 1010 (b) 1111
(c) 1110 (d) None of these

**21.** $100001_2 - 11110_2 =$

(a) 11 (b) 111
(c) 10 (d) None of these

**22.** Multiply 1111 by 11:

(a) 110101 (b) 101101
(c) 110100 (d) None of these

**23.** Multiply 101 by 11:

(a) 1111 (b) 1011
(c) 1110 (d) None of these

**24.** Multiply 101101 by 1101:

(a) 1111001001
(b) 1001101001
(c) 1001001001
(d) None of these

**25.** Multiply 11001 by 101:

(a) 1111101 (b) 1110101
(c) 1011101 (d) None of these

## ANSWER KEYS

### Exercise-I

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (a) | **3.** (c) | **4.** (c) | **5.** (a) | **6.** (b) | **7.** (a) | **8.** (c) | **9.** (b) | **10.** (a) | **11.** (c) | **12.** (a) | **13.** (b) |
| **14.** (c) | **15.** (a) | **16.** (b) | **17.** (a) | **18.** (c) | **19.** (b) | **20.** (c) | **21.** (a) | **22.** (b) | **23.** (a) | **24.** (c) | **25.** (a) | |

# EXPLANATORY ANSWERS

## Exercise-I

**1. (b)**

| | | Remainder |
|---|---|---|
| 2 | 117 | |
| 2 | 58 | 1 |
| 2 | 29 | 0 |
| 2 | 14 | 1 |
| 2 | 7 | 0 |
| 2 | 3 | 1 |
| | 1 | 1 |
| | 0 | 1 |

∴ The binary equivalent of decimal 117 is 1110101.

**2. (a)**

| | | Remainder |
|---|---|---|
| 2 | 52 | |
| 2 | 26 | 0 |
| 2 | 13 | 0 |
| 2 | 6 | 1 |
| 2 | 3 | 0 |
| | 1 | 1 |
| | 0 | 1 |

∴ The binary equivalent of decimal 52 is 110100.

**3. (c)**

| 1 | 1 | 1 | 0 | 1 | 0 | 1 |
|---|---|---|---|---|---|---|
| $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |

Delete the weights 23 and 21.

Adding the remaining weights, we get

$2^6 + 2^5 + 2^4 + 2^2 + 2^0 = 64 + 32 + 16 + 4 + 1 = 117$

i.e., $1110101_2 = 117_{10}$.

**4. (c)**

| | | Remainder |
|---|---|---|
| 2 | 235 | |
| 2 | 117 | 1 |
| 2 | 58 | 1 |
| 2 | 29 | 0 |
| 2 | 14 | 1 |
| 2 | 7 | 0 |
| 2 | 3 | 1 |
| | 1 | 1 |
| | 0 | 1 |

∴ $235_{10} = 11101011_2$

**5. (a)**

| | | Remainder |
|---|---|---|
| 2 | 701 | |
| 2 | 350 | 1 |
| 2 | 175 | 0 |
| 2 | 87 | 1 |
| 2 | 43 | 1 |
| 2 | 21 | 1 |
| 2 | 10 | 1 |
| 2 | 5 | 0 |
| 2 | 2 | 1 |
| | 1 | 0 |
| | 0 | 1 |

$\therefore\ (701)_{10} = 1010111101_2$.

**6. (b)**

$$\begin{array}{cccccc} 1 & 0 & 1 & 0 & 0 & 1 \\ 2^5 & 2^4 & 2^3 & 2^2 & 2^1 & 2^0 \end{array}$$

Decimal equivalent

$= 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 0 + 2^2 + 0 \times 2^1 + 1 \times 2^0$

$= 2^5 + 2^3 + 1 \times 2^0 = 32 = 32 + 8 + 1 = 41$.

**7. (a)**

$$\begin{array}{ccccccccccc} 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 1 \\ 2^{10} & 2^9 & 2^8 & 2^7 & 2^6 & 2^5 & 2^4 & 2^3 & 2^2 & 2^1 & 2^0 \end{array}$$

Decimal equivalent

$= 1 \times 2^{10} + 0 \times 2^9 + 0 \times 2^8 + 0 \times 2^7$

$+ 0 \times 2^6 + 0 \times 2^5 + 1 \times 2^4 + 0 \times 2^3$

$+ 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$

$= 2^{10} + 2^4 + 2^1 + 2^0 = 1043$.

**8. (c)**

$$\begin{array}{cccccc} 1 & 1 & 1 & 0 & 1 & 1 \\ 2^5 & 2^4 & 2^3 & 2^2 & 2^1 & 2^0 \end{array}$$

Decimal equivalent

$= 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$

$= 2^5 + 2^4 + 2^3 + 2^1 + 2^0 = 59$.

**9. (b)**

$$\begin{array}{r} 0101 \\ +1001 \\ \hline 1110 \end{array}$$

**10. (a)**

$$\begin{array}{r} 11100 \\ +\ 11010 \\ \hline 110110 \end{array}$$

**11. (c)**

$$\begin{array}{r} 11111 \\ 10001 \\ 1011 \\ \hline 111011 \end{array}$$

**12. (a)**

$$\begin{array}{r} 0011 \\ +\ 1 \\ \hline 0100 \end{array}$$

Column 1: $1 + 1 + 1 = 3;\ \frac{3}{2}$ = Quotient 1, Remainder 1

Column 2: $0 + 1 + 1 + 1$ (carry from first column)

$= 3;\ \frac{3}{2}$ = Quotient 1 and Remainder 1

Column 3: $0 + 0 + 1 + 1$ (carry from second column)

$= 2;\ \frac{2}{2}$ = Quotient 1 and Remainder 0

Column 4: $1 + 1 + 1$ (carry from column 3)

$= 4;\ \frac{4}{2}$ = Quotient 2 and Remainder 0

Column 5: $1 + 1 + 1 + 2$ (carry from column 4)

$= 5,\ 5_{10} = 101_2$.

***Note:***

Quotient in any column is carry for next column.

**13. (b)**

$$\begin{array}{r} 11 \\ 111 \\ 1111 \\ 11111 \\ \hline 111000 \\ \hline \end{array}$$

**14. (c)**

$$\begin{array}{r} 111 \\ 101 \\ \hline 1100 \end{array}$$

**15. (a)**

$$\begin{array}{r} 1000 \\ 1101 \\ 1111 \\ \hline 100100 \end{array}$$

**16. (b)**

$$\begin{array}{r} 111 \\ 101 \\ 011 \\ \hline 1111 \end{array}$$

**17. (a)** $111000_2 = 32 + 16 + 8 = 56$

$11001_2 = 16 + 8 + 1 = 25$

Since $11001_2 < 111000_2$, so we are to subtract a lower number from a higher number.

Making the digits equal in the number to be subtracted, we get 011001.

Complement of 011001 = 100110.

Adding 100110 to 111 000, we get

$$\begin{array}{r} 111000 \\ 100110 \\ \hline [1]011110 \\ \hline \end{array}$$

[1 in the [ ] is the 1 carried over]

Adding 1 to the extreme right digit in 011 110, we get

$$\begin{array}{r} 011110 \\ 1 \\ \hline 11111 \end{array}$$

$\therefore\ 111000_2 - 11001_2 = 11111$.

**18.** **(c)** $10001_2 = 2_4 + 1 = 17$,

$1111_2 = 2^3 + 2^2 + 2^1 + 1 = 15$.

Since $1111_2 < 10001_2$, we are to subtract a lower number from a higher number.

Making the digits equal in the number to be subtracted, we get

01111.

Complement of 01111 is 10000.

Adding 10000 to 10001, we get

$$\begin{array}{r} 10001 \\ 10000 \\ \hline [1]00001 \end{array}$$

Adding 1 to 1 in 00001, we get

$$\begin{array}{r} 00001 \\ 1 \\ \hline 00010 \end{array}$$

$\therefore\ 10001_2 - 1111_2 = 10$.

**19.** **(b)** Complement of $010111_2 = 101000$

Now,
$$\begin{array}{r} 111101 \\ +101000 \\ \hline [1]100101 \end{array}$$

Adding 1 to the extreme right digit in 100101, we get

$$\begin{array}{r} 100101 \\ + \quad 1 \\ \hline 100110 \end{array}$$

$\therefore\ 111101_2 - 10111_2 = 100110$.

**20.** **(c)** Complement of $10001_2 = 01110$.

Now,
$$\begin{array}{r} 11111 \\ +01110 \\ \hline [1]01101 \end{array} \qquad \begin{array}{r} 01101 \\ + \quad 1 \\ \hline 01110 \end{array}$$

$\therefore\ 11\ 111_2 - 10001_2 = 1110$.

**21.** **(a)** Complement of 011110 = 100001

Now,
$$\begin{array}{r} 100001 \\ +100001 \\ \hline [1]000010 \end{array} \qquad \begin{array}{r} 000010 \\ + \quad 1 \\ \hline 000011 \end{array}$$

$\therefore\ 100001_2 - 11110_2 = 11$.

**22.** **(b)**
$$\begin{array}{r} 1111 \\ 11 \\ \hline 11\ 11 \\ 1\ 11\ 1\phantom{1} \\ \hline 10\ 1101 \end{array}$$

**23.** **(a)**
$$\begin{array}{r} 101 \\ 11 \\ \hline 101 \\ 101\phantom{1} \\ \hline 1111 \end{array}$$

**24.** **(c)**
$$\begin{array}{r} 101101 \\ 1101 \\ \hline 101101 \\ 000000\phantom{0} \\ 101101\phantom{00} \\ \hline 1001001001 \end{array}$$

**25.** **(a)**
$$\begin{array}{r} 11001 \\ 101 \\ \hline 11001 \\ 00000\phantom{0} \\ 11001\phantom{00} \\ \hline 1111101 \end{array}$$

# Series

# 23

## INTRODUCTION

Now-a-days questions on series are asked in almost every competitive examination. These questions may involve numbers only, letters ($A$, $B$,...) only, or a combination of both.

## SERIES

A series is a sequence of numbers. These numbers are called *terms* of the sequence. All the terms of the sequence are arranged according to a certain predefined rule. After carefully studying the given series and finding the specific pattern in which the terms are changing, it is possible to find out the next term of the series.

## NUMBER SERIES

1. **Arithmetic Series** An arithmetic series is one in which the difference between any two consecutive terms is always the same and is called the common difference, that is, each successive number is obtained by adding (or subtracting) a fixed number to the previous number.

**Illustration 1:** Consider the series: 1, 3, 5, 7, 9, ....
Here, 2nd term − 1st term = 3rd term − 2nd term
= 4th term − 3rd term = ... = 2.
Hence, 1, 3, 5, 7, ... is an arithmetic series.

2. **Geometric series** A geometric series is one in which the ratio of any two consecutive terms is always the same and is called the common ratio, that is, each successive number is obtained by multiplying (or dividing) a fixed number by the previous number.

**Illustration 2:** The series given below:

(a) 2, 4, 8, 16, 32, ...
(b) 3, –6, 12, –24, 48,...
(c) $\frac{1}{4}, \frac{1}{12}, \frac{1}{36}, \frac{1}{100}$, ...
(d) $\frac{1}{5}, \frac{1}{30}, \frac{1}{180} = \frac{1}{1080}$, ...
(e) $x, x^2, x^3, x^4$, ... (where $x$ is any fixed real number),

are all geometric series. The ratio of any term in (a) to the preceding term is 2. The corresponding ratios in (b), (c), (d) and (e) are –2, $\frac{1}{3}, \frac{1}{6}$ and $x$, respectively.

3. **Series of squares, cubes and so on.** Simple powers of natural numbers (squares, cubes, etc.) or their combinations are sometimes used to form some series.

**Illustrations 3:**

(a) 4, 9, 16, 25, 36, ...

Each term in this series is a perfect square. The square roots of the terms are 2, 3, 4, 5, 6, ... . Clearly, the square roots of the terms of the given series are forming an arithmetic series with common difference 1. So, the next term of the series will be $(6 + 1)^2$, that is, 49.

(b) 1, 27, 125, 343, ...

Each term in this series is a perfect cube. The cube roots of its terms are 1, 3, 5, 7, ... clearly, the cube roots of the terms of the given series are forming an arithmetic series with common difference 2.

So, the next term of the series will be $9^3$, that is, 729.

(c) $\frac{1}{8}, \frac{4}{27}, \frac{9}{64}, \frac{16}{125}$, ...

In the above series, the numerators are squares of natural number ($n$), while the denominators are cubes of ($n$ + 1).

So, the next term of the series will be $\frac{25}{216}$.

4. **Arithmetic series of second order** We know that in an arithmetic series, the difference of any two consecutive terms is always the same. This is arithmetic series of first order.

A series in which the difference between successive terms themselves form an arithmetic series is called an arithmetic series of second order.

**Illustration 4:** Consider the series 1, 3, 7, 13, ...
The difference between successive terms of the above series are 2, 4, 6, ... which form an arithmetic series with common difference 2.
So, the next term of the series will be (13 + 8), that is, 21.

5. **Arithmetic series of third order** A series in which the difference between successive terms themselves form an arithmetic series of second order, is called an arithmetic series of third order.

**Illustration 5:** Consider the series: 2, 9, 17, 28, ...

The difference of successive terms of the above series are 7, 8, 11, 16, ...

The difference of successive terms of the above series are 1, 3, 5, ... which forms an arithmetic series with common difference 2.

So, the next term of the series will be (28 + 16), i.e., 44.

In this manner, we can construct arithmetic series of higher order.

6. **Arithmetico-Geometric series** In this series each successive term is obtained by first adding a fixed number to the previous term and then multiplying it by another fixed number.

**Illustration 6:** The series: 1, 9, 33, 105, ... is an arithmetico-geometric series as each successive term is obtained by first adding 2 to the previous term and multiplying it by 3.

So, the next term of the series will be $(105 + 2) \times 3$, that is, 321.

It is important to note that the differences of successive numbers in the above series are 8, 24, 72, ... which are forming a geometric series.

7. **Geometrico-Arithmetic series** In this series each successive term is obtained by first multiplying (or dividing) the previous term by a fixed number and then adding (or subtracting) another fixed number.

**Illustration 7:** The series: 2, 5, 17, 65, .... is a geometrico-arithmetic series as each successive term is obtained by first multiplying the previous term by 4 and then subtracting 3 from it.

So, the next term of the series will be $(65 \times 4) - 3$, that is, 257.

Again, note that the differences of successive numbers in the above series are 3, 12, 48, ... which are forming a geometric series.

8. **Double series** It consists of two series combined into a single series. The alternating terms of this series form an independent series.

**Illustration 8:** Consider the series:

1, 2, 4, 6, 7, 18, 10, 54, ....

Terms at odd places of the series: 1, 4, 7, 10, .... is an arithmetic series.

Terms at even places of the series: 2, 6, 18, 54, .... is a geometric series.

So, the next term of the series will be (10 + 3), that is, 13.

### Finding the wrong term in a series

In such questions, a number series is given of which all others except one are similar in some respect. The one term of the sequence does not follow the same pattern as is followed by the others. This one is the wrong term in the series. To find the wrong term in a given series we must study the given series carefully and find the pattern/rule in which the terms are changing. After that, we should find which of the terms is not changing according that pattern/rule. Thus, the wrong term is found.

**Illustration 9:** Find the wrong term in the given series: 5, 10, 17, 24, 37, 50, 65.

**Solution:** The terms of the series are in the following order:

$2^2 + 1, 3^2 + 1, 4^2 + 1, 5^2 + 1, 6^2 + 1, 7^2 + 1, 8^2 + 1$

Clearly, fourth term of the series, that is, 24 should be replaced by 26 so that all the terms of the series follow a particular pattern. Thus, 24 is the wrong term in the given series.

### Finding the missing term of the series

In such questions, a number series is given in which a blank space or question mark is provided in place of any one term of the series. The term at the blank space follow the same pattern as followed by other terms. We are required to find the missing term to replace the blank space or question mark.

**Illustration 10:** Find the missing term in the given series: 49, 56, 64, 72, ?, 90, 100

**Solution:** The terms of the series are in the following order

$7^2, 7^2 + 7, 8^2, 8^2 + 8, 9^2, 9^2 + 9, 10^2$

Clearly, fifth term in place of question mark will be $9^2$, that is, 81.

## SOME SPECIAL SERIES

1. **Series of Date or Time**

(a) Consider the series,

3 – 2 – 2004, 13 – 2 – 2004, 23 – 2 – 2004, 5 – 3 – 2004,

Here, each successive date differs by 10 days. Since 2004 is a leap year, 5 – 3 – 2004 should be replaced by 4 – 3 – 2004.

(b) Consider the series,

3.35, 5.00, 6.25, 7.40, 9.15, 10.40

Here, each successive time differs by 1 hour 25 min. Therefore, 7.40 should be replaced by 7.50.

**2. Numbers followed by their L.C.M. or H.C.F**

(a) Consider the series,

1, 2, 3, 6, 4, 5, 6, 60, 5, 6, 7, ....?

| 1st part | 2nd part | 3rd part |
|---|---|---|
| 1, 2, 3, 6 | 4, 5, 6, 60 | 5, 6, 7 ? |

Here, in each part fourth number is L.C.M. of first three numbers. Thus, the number in place of question mark will be 210 (L.C.M. of 5, 6, 7).

(b) Consider the series,

8, 4, 4, 7, 8, 1, 3, 9, 3, 2, 1, ?

| 1st part | 2nd part | 3rd part | 4th part |
|---|---|---|---|
| 8, 4, 4 | 7, 8, 1 | 3, 9, 3 | 2, 1 ? |

Here, in each part third number is H.C.F. of first two numbers. Thus, the number in place of question mark will be 1 ( H.C.F. of 2, 1,).

**3. Numbers Followed by their Product**

Consider the series,

1, 3, 3, 9, 27, 243, ?

Here, $1 \times 3 = 3$
$3 \times 3 = 9$
$3 \times 9 = 27$
$9 \times 27 = 243$
$27 \times 243 = 6561$

Thus, the number in place of question mark will be $27 \times 243$, that is, 6561.

**4. By Use of Digit Sum**

Consider the series,

11, 13, 17, 25, 32, ?

Here, $13 = 11 + (1 + 1)$
$17 = 13 + (1 + 3)$
$25 = 17 + (1 + 7)$
$32 = 25 + (2 + 5)$

That is, next number = previous number + digit sum of pervious number.

Thus, the number in place of question mark will be $32 + (3 + 2) = 37$.

## Alpha–Numeric Series

Such series involve the use of both the letters of the alphabet as well as the numbers. It is a two-line series. One line is a number series while the other line is an alphabet series. The terms of both the series follow the same pattern/rule. One of these two series is completely known. We have to find the required number of the incomplete series.

**Illustration 11:** 2, 7, 17, 37, 77,
3, *a*, *b*, *c*, *d*,

$$2 \xrightarrow{\times 2 + 3} 7 \xrightarrow{\times 2 + 3} 17 \xrightarrow{\times 2 + 3} 37 \xrightarrow{\times 2 + 3} 77$$

$\therefore \quad a = 3 \times 2 + 3 = 9$

$b = 9 \times 2 + 3 = 21$

$c = 21 \times 2 + 3 = 45$

$d = 45 \times 2 + 3 = 93$

## EXERCISE-I

**1.** Insert the missing number

5, 8, 12, 17, 23, ___, 38

(a) 29 (b) 30
(c) 32 (d) 25

**2.** Insert the missing number

4, 9, 20, 43, 90, ___

(a) 185 (b) 172
(c) 179 (d) 165

**3.** Insert the missing number

1, 1, 4, 8, 9, 27, 16, ___

(a) 25 (b) 36
(c) 125 (d) 64

**4.** Fill in the missing number

2, 6, 3, 4, 20, 5, 6, ?, 7

(a) 25 (b) 42
(c) 24 (d) 18

**5.** Fill in the missing number

1, 5, 11, 19, 29, ?

(a) 47 (b) 41
(c) 39 (d) 55

**6.** Fill in the missing number

3, 6, 21, 28, 55, 66, ?, 120

(a) 106 (b) 108
(c) 105 (d) 102

**7.** Fill in the missing number

5, 13, 25, 41, ?, 85, 113, 145

(a) 42 (b) 64
(c) 63 (d) 61

**8.** Fill in the missing number
4, 5, 9, 18, 34, ?

(a) 42 (b) 59
(c) 38 (d) None of these

**9.** Fill in the missing number

1799, 899, 449, ?

(a) 333 (b) 114
(c) 111 (d) 224

**10.** Fill in the missing number
2, 1, 2, 4, 4, 5, 6, 8, 8, 10, 11, ?

(a) 12 (b) 8
(c) 10 (d) 9

**11.** Fill in the missing number
5, 11, 19, 29, ?

(a) 31 (b) 52
(c) 41 (d) 51

**12.** Fill in the missing number
0, 3, 12, 30, ?, 105, 168

(a) 61 (b) 62
(c) 60 (d) 63

**13.** Fill in the missing number
15, 20, 30, ?

(a) 45 (b) 40
(c) 48 (d) 50

**14.** Fill in the missing number
11, 10, ?, 100, 1001, 1000, 1001

(a) 110 (b) 111
(c) 101 (d) None of these

**15.** Fill in the missing number
99, 95, 86, 70, ?

(a) 45 (b) 62
(c) 65 (d) 55

**16.** Fill in the missing number
5, 18, 10, 12, 15, ?

(a) 4 (b) 8
(c) 6 (d) 10

**17.** Fill in the missing number
12, 8, 14, 6, 16, ?

(a) 18 (b) 4
(c) 32 (d) 10

**18.** Fill in the missing number
13, 21, 29, 34, 43, 92, 12, ?

(a) 84 (b) 31
(c) 92 (d) 12

**19.** Fill in the missing number
3, 15, 35, ... , 99, 143

(a) 68 (b) 58
(c) 63 (d) 45

**20.** Fill in the missing number
4, 7, 11, 18, 29, 47, ?, 123, 199

(a) 71 (b) 82
(c) 86 (d) 76

In the following number series a wrong number is given. Find out the wrong number.

**21.** 455, 445, 465, 435, 485, 415, 475

(a) 475 (b) 465
(c) 435 (d) 455
(e) 445

**22.** 3, 10, 24, 54, 108, 220, 444

(a) 108 (b) 10
(c) 24 (d) 54
(e) 220

**23.** 8, 18, 40, 86, 178, 370, 752

(a) 86 (b) 178
(c) 40 (d) 370
(e) 752

**24.** 1, 2, 6, 21, 84, 445, 2676

(a) 6 (b) 21
(c) 2676 (d) 84
(e) 445

**25.** 1, 16, 9, 64, 25, 216, 49

(a) 64 (b) 216
(c) 16 (d) 49
(e) 9

**26.** 864, 420, 200, 96, 40, 16, 6

(a) 864 (b) 200
(c) 96 (d) 16
(e) 40

**27.** 9, 13, 21, 37, 69, 132, 261

(a) 9 (b) 13
(c) 261 (d) 261
(e) 132

**28.** 2, 5, 18, 19, 24, 29, 34

(a) 18 (b) 2
(c) 19 (d) 29
(e) 34

**29.** 1, 5, 11, 19, 29, 55

(a) 29 (b) 55
(c) 11 (d) 5

**30.** 2, 4, 4, 16, 8, 256, 64

(a) 8 (b) 16
(c) 64 (d) 256
(e) 4

**Directions (31–40):** In each of the questions below a number series has been given followed by five alternatives. One term of the given number series is wrong. Find out that wrong term and spot out a number from the alternatives which will replace the wrong term of the series.

**31.** 2, 9, 28, 65, 126, 216, 344

(a) 38 (b) 217
(c) 356 (d) 66

**32.** 58, 57, 54, 50, 42, 33, 22

(a) 48 (b) 49
(c) 52 (d) 30
(e) 18

**33.** 0, 9, 64, 169, 576, 1225

(a) 225 (b) 360
(c) 444 (d) 556
(e) 630

**34.** 1, 3, 7, 19, 42, 89, 184

(a) 8 (b) 9
(c) 24 (d) 30
(e) 182

**35.** 169, 121, 80, 49, 25, 9, 1

(a) 100 (b) 81
(c) 36 (d) 16
(e) 4

**36.** 7, 9, 17, 42, 91, 172, 293

(a) 16 (b) 25
(c) 36 (d) 8
(e) 49

**37.** 8, 14, 26, 48, 98, 194, 386

(a) 60 (b) 50
(c) 72 (d) 96
(e) 108

**38.** 95, 86, 73, 62, 47, 30, 11

(a) 90 (b) 75
(c) 64 (d) 35
(e) 15

**39.** 7, 14, 56, 168, 336, 1344, 2688, 8064

(a) 3032 (b) 5032
(c) 4032 (d) 2680
(e) 332

**40.** 11, 15, 17, 19, 23, 25

(a) 1 (b) 18
(c) 21 (d) 10
(e) 13

**Direction (41–49):** In each of the following questions a number series is given. After the series a number is given followed by (A), (B), (C), (D) and (E). Complete the series starting with the number given following the sequence of the given series. Then, answer the question given below each:

**41.** 1 9 65 393

2 (A) (B) (C) (D) (E)

Which of the following numbers will come in place of (C)?

(a) 490 (b) 729
(c) 854 (d) 734
(e) None of these

**42.** 616, 496, 397, 317, 254,

838 (A), (B), (C), (D), (E),

Which of the following numbers will come in place of (E)?

(a) 428 (b) 608
(c) 426 (d) 529
(e) 712

**43.** 434, 353, 417, 368, 404, 379,

108 (A), (B), (C), (D), (E)

Which of the following numbers will come in place of (E)?

(a) 27 (b) 91
(c) 42 (d) 53
(e) 78

**44.** 4, 16, 48, 120, 272,

124, (A), (B), (C), (D), (E)

Which of the following numbers will come in place of (C)?

(a) 4424 (b) 256
(c) 528 (d) 1080
(e) 2192

**45.** 1, 9, 65, 393,

2, (A), (B), (C), (D), (E)

Which of the following numbers will come in place of (C)?

(a) 490 (b) 729
(c) 854 (d) 734
(e) None of these

**46.** 848, 420, 206, 99, 45.5,

664, (A), (B), (C), (D), (E)

Which of the following numbers will come in place of (D)?

(a) 32 (b) 34
(c) 160 (d) 328
(e) 13

**47.** 8, 8, 12, 24,

36 (A), (B), (C), (D), (E)

Which of the following numbers will come in place of (E)?

(a) 108 (b) 36
(c) 810 (d) 54
(e) None of these

**48.** 6, 14, 35, 111, 449,

3 (A), (B), (C), (D), (E)

Which of the following numbers will come in place of (B)?

(a) 93 (b) 377
(c) 1892 (d) 11
(e) 29

**49.** 8, 49, 288, 1435, 5736,

5 (A), (B), (C), (D), (E)

Which of the following numbers will come in place of (E)?

(a) 162 (b) 805
(c) 9645 (d) 3216
(e) 28

## Exercise-2
## (Based on Memory)

**1.** The missing number in the sequence 0, 2, 8, 18, ..., 50 is:

(a) 28 (b) 30
(c) 32 (d) 36

**[SSC (GL) Prel. Examination, 2005]**

**2.** The next number in the sequence 2, 5, 10, 14, 18, 23, 26, 32, ... is:

(a) 33 (b) 34
(c) 36 (d) 37

**[SSC (GL) Prel. Examination, 2005]**

**Directions (3–15):** What should come in place of the question mark (?) in the following number series?

**3.** 7413, 7422, 7440, ?, 7503, 7548

(a) 7464 (b) 7456
(c) 7466 (d) 7477
(e) None of these

**[SBI PO, 2008]**

**4.** 4, 16, 36, 64, 100, ?

(a) 120 (b) 180
(c) 136 (d) 144
(e) None of these

**[SBI PO, 2008]**

**5.** 12, 33, 96, ?, 852, 2553

(a) 285 (b) 288
(c) 250 (d) 384
(e) None of these **[SBI PO, 2008]**

**6.** 70000, 14000, 2800, ?, 112, 22.4

(a) 640 (b) 420
(c) 560 (d) 540
(e) None of these **[SBI PO, 2008]**

**7.** 102, 99, 104, 97, 106, ?

(a) 96 (b) 95
(c) 100 (d) 94
(e) None of these **[SBI PO, 2008]**

**8.** 14, 43.5, 264, ?, 76188

(a) 3168 (b) 3176
(c) 1587 (d) 1590
(e) None of these

**[Bank of Maharashtra PO, 2008]**

**9.** 41, 164, 2624, ?, 6045696

(a) 104244 (b) 94644
(c) 94464 (d) 102444
(e) None of these

**[Bank of Maharashtra PO, 2008]**

**10.** 32, 49, 83, 151, 287, 559, ?

(a) 1118 (b) 979
(c) 1103 (d) 1120
(e) None of these

**[Andhra Bank PO, 2006]**

**11.** 12, 14, 17, 13, 8, 14, 21, 13, 4, ?

(a) 14 (b) 13
(c) 15 (d) 2
(e) None of these

**[Corporation Bank PO, 2006]**

**12.** 4, 6, 12, 30, 90, 315, ?

(a) 945 (b) 1102
(c) 1260 (d) 1417.5
(e) None of these

**[Corporation Bank PO, 2006]**

**13.** 25, 16, ?, 4, 1

(a) 3 (b) 6
(c) 12 (d) 18
(e) None of these

**[Corporation Bank PO, 2006]**

**14.** 15, 12, 17, 10, ?, 8, 25, 6

(a) 3 (b) 7
(c) 21 (d) 19
(e) None of these

**[Corporation Bank PO, 2006]**

**15.** 15, 29, 57, 113, ?, 449

(a) 226 (b) 235
(c) 215 (d) 224
(e) None of these

**[LIC ADO Examination, 2007]**

**16.** In the following number series, one number is wrong. Find out the wrong number.
17, 22, 32, 45, 67, 92

(a) 67 (b) 32
(c) 22 (d) 45
(e) None of these

**[LIC ADO Examination, 2007]**

**Directions (17–20):** One number is wrong in each of the number series given in each of the following questions. You have to identify that number and assuming that a new series starts with that number following the same logic as in the given series, which of the numbers given in (a), (b), (c), (d) and (e) given below each series will be the third number in the new series?

**17.** 3 4 10 34 136 685 4116

(a) 22 (b) 276
(c) 72 (d) 1374
(e) 12

**[SBI PO, 1999]**

**18.** 214 18 162 62 143 90 106

(a) –34 (b) 110
(c) 10 (d) 91
(e) 38

**[SBI PO, 1999]**

**19.** 160 80 120 180 1050 4725 25987.5

(a) 60 (b) 90
(c) 3564 (d) 787.5
(e) 135

**[SBI PO, 1999]**

**20.** 2 3 7 13 26 26 47 78

(a) 11 (b) 13
(c) 15 (d) 18
(e) 20

**[SBI PO, 1999]**

**Directions (21–25):** In each of the questions given below there is a mathematical series. After the series a number is being given followed by (a), (b), (c), (d) and (e). You have to create another series after understanding the sequence of the given series which starts with the given number. Then, answer the question given below.

**21.** 1 9 65 393

2 (a) (b) (c) (d) (e)

Out of the following numbers which would come in the place of (c)?

(a) 490 (b) 853
(c) 731 (d) 729
(e) None of these

**[Bank of Baroda PO, 1999]**

**22.** 8 8 12 24

36 (a) (b) (c) (d) (e)

Out of the following numbers which would come in the place of (e)

(a) 810 (b) 36
(c) 54 (d) 108
(e) None of these

**[Bank of Baroda PO, 1999]**

**23.** 424 208 100 46

888 (a) (b) (c) (d) (e)

What number would come in place of (b)?

(a) 20 (b) 440
(c) 216 (d) 56
(e) None of these

**[Bank of Baroda PO, 1999]**

**24.** 4 5 9.75 23.5

7 (a) (b) (c) (d) (e)

What number would come in the place of (d)?

(a) 32.5 (b) 271.5
(c) 8 (d) 14.25
(e) None of these

**[Bank of Baroda PO, 1999]**

**25.** 5 294 69 238

13 (a) (b) (c) (d) (e)

Which of the following numbers would come in the place of (e)?

(a) 246 (b) 206
(c) 125 (d) 302
(e) None of these

**[Bank of Baroda PO, 1999]**

**Directions (26–30):** In each of the following questions a number series is given. Only one number is wrong in each series. Find out that wrong number, and taking this wrong number as the first term of the second series formed following the same logic, find out the third term of the second series.

**26.** 1 2 8 21 88 445

(a) 24.5 (b) 25
(c) 25.5 (d) 24
(e) None of these

**[SBI Associates PO, 1999]**

**27.** 6 7 18 63 265 1365

(a) 530 (b) 534
(c) 526 (d) 562
(e) None of these

**[SBI Associates PO, 1999]**

**28.** 7 23 58 127 269 555

(a) 263 (b) 261
(c) 299 (d) 286
(e) None of these

**29.** 2 7 28 146 877 6140

(a) 242 (b) 246
(c) 252 (d) 341
(e) None of these

**[SBI Associates PO, 1999]**

**30.** 1 2 6 33 148 765 4626

(a) 46 (b) 124
(c) 18 (d) 82
(e) None of these

**[SBI Associates PO, 1999]**

**31.** 7, 9, 13, 21, 37, ?

(a) 58 (b) 63
(c) 69 (d) 72

**[SSC (GL), 2010]**

**32.** 36, 28, 24, 22, ?

(a) 18 (b) 19
(c) 21 (d) 22

**[SSC (GL), 2010]**

**33.** 0, 4, 18, 48, ?, 180

(a) 58 (b) 68
(c) 84 (d) 100

**[SSC (GL), 2010]**

**34.** 987:IHG :: 654:?

(a) FDE (b) FED
(c) EFD (d) DEF

**[SSC (GL), 2010]**

**35.** 24:126 :: 48:?

(a) 433 (b) 192
(c) 240 (d) 344

**[SSC (GL), 2010]**

**36.** 1:8 :: 27:?

(a) 37 (b) 47
(c) 57 (d) 64

**[SSC (GL), 2010]**

**37.** Find the wrong number in the series:
6, 9, 15, 22, 51, 99

(a) 99 (b) 51
(c) 22 (d) 15

**[SSC (GL), 2011]**

**38.** 8, 15, 36, 99, 288, ...?

(a) 368 (b) 676
(c) 855 (d) 908

**[SSC (GL), 2011]**

**39.** 4, 196, 16, 169, ? , 144, 64

(a) 21 (b) 81
(c) 36 (d) 32

**[SSC (GL), 2011]**

**40.** Find out the questioned number. 6:5:: 8:?

(a) 2 (b) 4
(c) 6 (d) 10

**[SSC (GL), 2011]**

**41.** 5, 21, 69, 213, 645, __?

(a) 1670 (b) 1941
(c) 720 (d) 1320

**[SSC (GL), 2011]**

**42.** 121, 144, 289, 324, 529, 576, __?

(a) 961 (b) 841
(c) 900 (d) 729

**[SSC (GL), 2011]**

**43.** 14, 19, 29, 49, 89, __?

(a) 139 (b) 149
(c) 159 (d) 169

**[SSC (GL), 2011]**

**44.** 34, 18, 10, ?

(a) 8 (b) 5
(c) 7 (d) 6

**[SSC (GL), 2011]**

**45.** 9, 8, 10, 16, 11, ?, 12, 64

(a) 28 (b) 36
(c) 25 (d) 32

**[SSC (GL), 2011]**

**46.** 7, 8, 18, 57, ?

(a) 232 (b) 228
(c) 234 (d) 226
(e) None of these

**[Gramin Bank U.P. (SO) Examination, 2012]**

**47.** 7, 11, 19, 35, ?

(a) 71 (b) 69
(c) 65 (d) 73
(e) None of these

**[Gramin Bank U.P. (SO) Examination, 2012]**

**48.** 5, 11, 23, ?, 95

(a) 45 (b) 49
(c) 47 (d) 46
(e) None of these

**[Gramin Bank U.P. (SO) Examination, 2012]**

**49.** 17, 22, 52, 165, ?

(a) 648 (b) 468
(c) 334 (d) 668
(e) None of these

**[Gramin Bank U.P. (SO) Examination, 2012]**

**50.** Find the value of $x$ in the series 2, 6, 30, 210, $x$, 30030, ...

(a) 2310 (b) 1890
(c) 2520 (d) 2730

**[UPPCS, 2012]**

**Directions (Q. 51 to 55):** In each of these questions, one term in the given number series is wrong. Find out the wrong term.

**51.** 142 119 100 83 65 59 52

(a) 65 (b) 100
(c) 59 (d) 119
(e) None of these

**[Bank of Baroda PO, 2010]**

**52.** 8 12 24 46 72 108 152

(a) 12 (b) 24
(c) 46 (d) 72
(e) None of these

**[Bank of Baroda PO, 2010]**

**53.** 13 25 40 57 79 103 130

(a) 25 (b) 40
(c) 57 (d) 79
(e) None of these

**[Bank of Baroda PO, 2010]**

**54.** 2 10 18 54 162 486 1458

(a) 18 (b) 54
(c) 162 (d) 10
(e) None of these

**[Bank of Baroda PO, 2010]**

**55.** 850 600 550 500 475 462.5 456.25

(a) 600 (b) 550
(c) 500 (d) 462.5
(e) None of these

**[Bank of Baroda PO, 2010]**

**56.** 12 12 18 36 90 270 ?

(a) 945 (b) 810
(c) 1080 (d) 1215
(e) None of these

**[Syndicate Bank PO, 2010]**

**57.** 1015 508 255 129 66.5 ? 20.875

(a) 34.50 (b) 35
(c) 35.30 (d) 35.75
(e) None of these

**[Syndicate Bank PO, 2010]**

**58.** 8 9 20 63 256 1285 ?

(a) 6430 (b) 7450
(c) 7716 (d) 7746
(e) None of these

**[Syndicate Bank PO, 2010]**

**59.** 980 484 236 112 50 ? 3.5

(a) 25 (b) 17
(c) 21 (d) 29
(e) None of these

**[Syndicate Bank PO, 2010]**

**Directions (Q. 60 to 69):** In each of these questions, one term in the given number series is wrong. Find out the wrong term.

**60.** 484 240 120 57 26.5 11.25 3.625

(a) 240 (b) 120
(c) 57 (d) 26.5
(e) 11.25

**[Allahabad Bank PO, 2010]**

**61.** 3 5 13 43 176 891 5353

(a) 5 (b) 13
(c) 43 (d) 176
(e) 891

**[Allahabad Bank PO, 2010]**

**62.** 6 7 16 41 90 154 292

(a) 7 (b) 16
(c) 41 (d) 90
(e) 154 **[Allahabad Bank PO, 2010]**

**63.** 5 7 16 57 244 1245 7506

(a) 7 (b) 16
(c) 57 (d) 244
(e) 1245 **[Allahabad Bank PO, 2010]**

**64.** 4 2.5 3.5 6.5 15.5 41.25 126.75

(a) 2.5 (b) 3.5
(c) 6.5 (d) 15.5
(e) 41.25

**[Allahabad Bank PO, 2010]**

**65.** 32 34 37 46 62 87 123

(a) 34 (b) 37
(c) 62 (d) 87
(e) 46

**[Punjab and Sind Bank PO, 2010]**

**66.** 7 18 40 106 183 282 403

(a) 18 (b) 282
(c) 40 (d) 106
(e) 183

**[Punjab and Sind Bank PO, 2010]**

**67.** 850 843 829 808 788 745 703

(a) 843 (b) 829
(c) 808 (d) 788
(e) 745

**[Punjab and Sind Bank PO, 2010]**

**68.** 33 321 465 537 590 600

(a) 321 (b) 465
(c) 573 (d) 537
(e) 590

**[Punjab and Sind Bank PO, 2010]**

**69.** 37 47 52 67 87 112 142

(a) 47 (b) 52
(c) 67 (d) 87
(e) 112

**[Punjab and Sind Bank PO, 2010]**

**70.** 586 587 586 581 570 ? 522

(a) 545 (b) 543
(c) 551 (d) 557
(e) None of these

**[Punjab National Bank PO, 2010]**

**71.** 64 54 69 49 74 44 ?

(a) 89 (b) 69
(c) 59 (d) 99
(e) None of these

**[Punjab National Bank PO, 2010]**

**72.** 4000 2008 1012 ? 265 140.5 78.25

(a) 506 (b) 514
(c) 520 (d) 512
(e) None of these

**[Punjab National Bank PO, 2010]**

**73.** 5 5 15 75? 4725 51975

(a) 520 (b) 450
(c) 525 (d) 300
(e) None of these

**[Punjab National Bank PO, 2010]**

**74.** 52 26 26 39 78 ? 585

(a) 195 (b) 156
(c) 234 (d) 117
(e) None of these

**[Punjab National Bank PO, 2010]**

**75.** 7 20 46 98 202 ?

(a) 420 (b) 410
(c) 310 (d) 320
(e) None of these

**[Punjab National Bank PO, 2010]**

**76.** 210 209 213 186 202 ?

(a) 138 (b) 77
(c) 177 (d) 327
(e) None of these

**[CBI (PO), 2010]**

**77.** 27 38 71 126 203 ?

(a) 212 (b) 202
(c) 301 (d) 312
(e) None of these

**[CBI (PO), 2010]**

**78.** 435 354 282 219 165 ?

(a) 103 (b) 112
(c) 120 (d) 130
(e) None of these

**[CBI (PO), 2010]**

**79.** 4 200 369 513 634 ?

(a) 788 (b) 715
(c) 734 (d) 755
(e) None of these

**[CBI (PO), 2010]**

**80.** 8 11 17 47 128 371 1100

(a) 11 (b) 47
(c) 17 (d) 371
(e) 128

**[Corporation Bank PO, 2009]**

**81.** 1 5 13 31 61 125 253

(a) 1 (b) 5
(c) 31 (d) 61
(e) 125

**[Corporation Bank PO, 2009]**

**82.** 325 314 288 247 191 ?

(a) 126 (b) 116
(c) 130 (d) 120
(e) None of these

**[Corporation Bank PO, 2010]**

**83.** 45 46 70 141 ? 1061.5

(a) 353 (b) 353.5
(c) 352.5 (d) 352
(e) None of these

**[Corporation Bank PO, 2010]**

**84.** 620 632 608 644 596 ?

(a) 536 (b) 556
(c) 656 (d) 646
(e) None of these

**[Corporation Bank PO, 2010]**

**85.** 15 25 40 65 ? 170

(a) 115 (b) 90
(c) 105 (d) 120
(e) None of these

**[Corporation Bank PO, 2010]**

**86.** 3 52 88 113 129 ?

(a) 128 (b) 142
(c) 133 (d) 145
(d) None of these

**[New Indian Insurance PO, 2009]**

**87.** 2 3 8 ? 112 565

(a) 36 (b) 14
(c) 27 (d) 45
(d) None of these

**[New Indian Insurance PO, 2009]**

**88.** 6 4 8 23 ? 385.25

(a) 84.5 (b) 73
(c) 78.5 (d) 82
(e) None of these

**[New Indian Insurance PO, 2009]**

**89.** 8 64 216 512 ? 1728

(a) 729 (b) 1331
(c) 684 (d) 1000
(e) None of these

**[New Indian Insurance PO, 2009]**

**90.** 5 11 32 108 444 ?

(a) 1780 (b) 2230
(c) 1784 (d) 2225
(e) None of these

**[New Indian Insurance PO, 2009]**

**91.** 9 11 15 ? 39 71

(a) 29 (b) 23
(c) 21 (d) 27
(e) None of these

**[Haryana Grameen Bank PO, 2009]**

**92.** 7 8 12 21 ? 62

(a) 42 (b) 51
(c) 48 (d) 35
(e) None of these

**[Haryana Grameen Bank PO, 2009]**

**93.** 5 6 16 57 244 ?

(a) 1225 (b) 992
(c) 964 (d) 1245
(e) None of these

**[Haryana Grameen Bank PO, 2009]**

**94.** 3 19 97 391 ? 2359

(a) 1084 (b) 1567
(c) 1177 (d) 1958
(e) None of these

**[Haryana Grameen Bank PO, 2009]**

**95.** 848 422 208 100 45 ?

(a) 16.5 (b) 18
(c) 22.5 (d) 24
(e) None of these

**[Haryana Grameen Bank PO, 2009]**

**Directions (Q. 96 to 100):** Mark the wrong number in the series

**96.** 7.5 47.5 87.5 157.5 247.5 357.5 487.5

(a) 357.5 (b) 87.5
(c) 157.5 (d) 7.5
(e) 47.5

**[Andhra Bank PO, 2007]**

**97.** 1500 1581 1664 1749 1833 1925 2016

(a) 1581 (b) 1664
(c) 1833 (d) 1925
(e) 1749

**[Andhra Bank PO, 2007]**

**98.** 1331 2197 3375 4914 6859 9261 12167

(a) 4914 (b) 6859
(c) 9261 (d) 2197
(e) 12167

**[Andhra Bank PO, 2007]**

**99.** 13 16 21 27 39 52 69

(a) 21 (b) 39
(c) 27 (d) 52
(e) 16

**[Andhra Bank PO, 2007]**

**100.** 66 91 120 153 190 233 276

(a) 120 (b) 233
(c) 153 (d) 276
(e) 190

**[Andhra Bank PO, 2007]**

**101.** 2 8 26 ? 242

(a) 78 (b) 72
(c) 82 (d) 84
(e) None of these

**[Andhra Bank PO, 2009]**

**102.** 3 4 12 ? 196

(a) 45 (b) 40
(c) 41 (d) 49
(e) None of these

**[Andhra Bank PO, 2009]**

**103.** 9 17 ? 65 129

(a) 32 (b) 24
(c) 35 (d) 33
(e) None of these

**[Andhra Bank PO, 2009]**

**104.** 7 13 ? 49 97

(a) 27 (b) 25
(c) 23 (d) 29
(e) None of these

**[Andhra Bank PO, 2009]**

**105.** 5 3 6 ? 64.75

(a) 15 (b) 15.5
(c) 17.5 (d) 17.25
(e) None of these

**[Andhra Bank PO, 2009]**

**106.** 12 12 18 45 180 1170 ?

(a) 12285 (b) 10530
(c) 11700 (d) 12870
(e) 7605

**[IOB PO, 2008]**

**107.** 444 467 513 582 674 789 ?

(a) 950 (b) 904
(c) 927 (d) 881
(e) 973

**[IOB PO, 2008]**

**108.** 1 16 81 256 625 1296 ?

(a) 4096 (b) 2401
(c) 1764 (d) 3136
(e) 6561

**[IOB PO, 2008]**

**109.** 23 25 53 163 657 3291 ?

(a) 16461 (b) 13169
(c) 9877 (d) 23045
(e) 19753

**[IOB PO, 2008]**

**110.** 13 13 65 585 7605 129285 ?

(a) 2456415 (b) 2235675
(c) 2980565 (d) 2714985
(e) 2197845

**[IOB PO, 2008]**

**111.** 649.6875 1299.375 866.25 346.5 99 22 ?

(a) 4 (b) 7
(c) 10 (d) 12
(e) None of these

**[Uttrakhand GBO PO, 2007]**

**112.** 30 16 10 8 8 9 ?

(a) 12.75 (b) 13
(c) 14 (d) 10.5
(e) None of these

**[Uttrakhand GBO PO, 2007]**

**113.** 10 18 63 253 1137 5901 ?

(a) 39754 (b) 35749
(c) 37594 (d) 35794
(e) None of these

**[Uttrakhand GBO PO, 2007]**

**114.** 11 26 58 124 258 528 ?

(a) 1020 (b) 1135
(c) 1285 (d) 1340
(e) None of these

**[Uttrakhand GBO PO, 2007]**

**115.** 738 765 819 900 1008 1143 ?

(a) 1445 (b) 1565
(c) 1305 (d) 1275
(e) None of these

**[Uttrakhand GBO PO, 2007]**

**116.** 9050 5675 3478 2147 1418 1077 950

(a) 3478 (b) 1418
(c) 5675 (d) 2147
(e) 1077

**[IBPS Bank PO, 2011]**

**117.** 7 12 40 222 1742 17390 208608

(a) 7 (b) 12
(c) 40 (d) 1742
(e) 208608

**[IBPS Bank PO, 2011]**

**118.** 6 91 584 2935 11756 35277 70558

(a) 91 (b) 70558
(c) 584 (d) 2935
(e) 35277

**[IBPS Bank PO, 2011]**

**119.** 1 4 25 256 3125 46656 823543

(a) 3125 (b) 823543
(c) 46656 (d) 25
(e) 256

**[IBPS Bank PO, 2011]**

**120.** 8424 4212 2106 1051 526.5 263.25 131.625

(a) 131.625 (b) 1051
(c) 4212 (d) 8424
(e) 263.25

**[IBPS Bank PO, 2011]**

**121.** 4 5 12 38 160 805 4836

(a) 12 (b) 160
(c) 38 (d) 805
(e) None of these

**[OBC PO, 2009]**

**122.** 3 7 16 32 56 93 142

(a) 56 (b) 16
(c) 32 (d) 7
(e) None of these

**[OBC PO, 2009]**

**123.** 11 18 29 42 59 80 101

(a) 42 (b) 18
(c) 29 (d) 59
(e) None of these

**[OBC PO, 2009]**

**124.** 2 9 32 105 436 2159 13182

(a) 436 (b) 2195
(c) 9 (d) 32
(e) None of these

**[OBC PO, 2009]**

**125.** 5 5 495 3465 17325 34650 51975

(a) 495 (b) 34650
(c) 55 (d) 17325
(e) None of these

**[OBC PO, 2009]**

**126.** 17 52 158 477 ? 4310

(a) 1433 (b) 1432
(c) 1435 (d) 1434
(e) None of these

**[United Bank of India PO, 2009]**

**127.** 3 22 ? 673 2696 8093

(a) 133 (b) 155
(c) 156 (d) 134
(e) None of these

**[United Bank of India PO, 2009]**

**128.** 6 13 38 ? 532 2675

(a) 129 (b) 123
(c) 172 (d) 164
(e) None of these

**[United Bank of India PO, 2009]**

**129.** 286 142 ? 34 16 7

(a) 66 (b) 72
(c) 64 (d) 74
(e) None of these

**[United Bank of India PO, 2009]**

**130.** 17 9 ? 16.5 35 90

(a) 5 (b) 15
(c) 10 (d) 20
(e) None of these

**[United Bank of India PO, 2009]**

**131.** 0 5 18 43 84 145 ?

(a) 220 (b) 240
(c) 260 (d) 280
(e) None of these

**[IOB PO, 2009]**

**132.** 10 17 48 165 688 3475 ?

(a) 27584 (b) 25670
(c) 21369 (d) 20892
(e) None of these

**[IOB PO, 2009]**

**133.** 1 3 24 360 8640 302400 ?

(a) 14525100 (b) 154152000
(c) 14515200 (d) 15425100
(e) None of these

**[IOB PO, 2009]**

**134.** 12 14 32 102 416 2090 ?

(a) 15522 (b) 12552
(c) 13525 (d) 17552
(e) None of these

**[IOB PO, 2009]**

**135.** 10 15 15 12.5 9.375 6.5625 ?

(a) 4.375 (b) 3.2375
(c) 4.6275 (d) 3.575
(e) None of these

**[IOB PO, 2009]**

**136.** 15 25 40 130 ? 2560

(a) 500 (b) 520
(c) 490 (d) 480
(e) None of these

**[NABARD Bank PO, 2009]**

**137.** 186 94 48 25 ? 7.75

(a) 13.5 (b) 14.8
(c) 12.5 (d) 14
(e) None of these

**[NABARD Bank PO, 2009]**

**138.** 124 112 176 420 1488 ?

(a) 8568 (b) 7140
(c) 5712 (d) 6150
(e) None of these

**[NABARD Bank PO, 2009]**

**139.** 384 381 372 345 264 ?

(a) 23 (b) 25
(c) 43 (d) 24
(e) None of these

**[NABARD Bank PO, 2009]**

**140.** 282 286 302 ? 402 502

(a) 366 (b) 318
(c) 326 (d) 338
(e) None of these

**[NABARD Bank PO, 2009]**

**141.** 2187 729 243 81 27 9 ?

(a) 36 (b) 3
(c) 18 (d) 6
(e) 12

**[SBI PO, 2008]**

**142.** 522 1235 2661 4800 7652 11217 ?

(a) 15495 (b) 16208
(c) 14782 (d) 16921
(e) 14069

**[SBI PO, 2008]**

**143.** 51975 9450 2100 600 240 160 ?

(a) 80 (b) 120
(c) 320 (d) 240
(e) 300

**[SBI PO, 2008]**

**144.** 4 18 48 100 180 294 ?

(a) 416 (b) 480
(c) 512 (d) 384
(e) 448

**[SBI PO, 2008]**

**145.** 6 26 134 666 3334 16666 ?

(a) 84344 (b) 83443
(c) 84434 (d) 83334
(e) 83344

**[SBI PO, 2008]**

**146.** 30 35 65 100 165 265 ?

(a) 270 (b) 520
(c) 430 (d) 395
(e) None of these

**[Dena Bank PO, 2008]**

**147.** 3 5 7 ? 13 17

(a) 9 (b) 10
(c) 11 (d) 8
(e) None of these

**[Dena Bank PO, 2008]**

**148.** 16 17 15 18 14 ?

(a) 10 (b) 17
(c) 18 (4) 20
(e) None of these

**[Dena Bank PO, 2008]**

**149.** 3125 256 ? 4 1

(a) 27 (b) 128
(c) 64 (d) 32
(e) None of these

**[Dena Bank PO, 2008]**

**150.** 2 3 6 18 108 ?

(a) 126 (b) 1944
(c) 648 (d) 756
(e) None of these

**[Dena Bank PO, 2008]**

**151.** 9 15 27 51 99 ?

(a) 165 (b) 195
(c) 180 (d) 190
(e) None of these

**[OBC PO, 2010]**

**152.** 13 21 36 58 87 ?

(a) 122 (b) 128
(c) 133 (d) 123
(e) None of these

**[OBC PO, 2010]**

**153.** 7 9 19 45 95 ?

(a) 150 (b) 160
(c) 145 (d) 177
(e) None of these

**[OBC PO, 2010]**

**154.** 14 15 23 32 96 ?

(a) 121 (b) 124
(c) 152 (d) 111
(e) None of these

**[OBC PO, 2010]**

**155.** 20 24 36 56 84 ?

(a) 116 (b) 124
(c) 120 (d) 128
(e) None of these

**[OBC PO, 2010]**

**156.** 117 389 525 593 627 (?)

(a) 654 (b) 640
(c) 634 (d) 630
(e) None of these

**[Union Bank of India PO, 2011]**

**157.** 7 11 23 51 103 (?)

(a) 186 (b) 188
(c) 185 (d) 187
(e) None of these

**[Union Bank of India PO, 2011]**

**158.** 18 27 49 84 132 (?)

(a) 190 (b) 183
(c) 180 (d) 193
(e) None of these

**[Union Bank of India PO, 2011]**

**159.** 33 43 65 99 145 (?)

(a) 201 (b) 203
(c) 205 (d) 211
(e) None of these

**[Union Bank of India PO, 2011]**

**160.** 655 439 314 250 223 (?)

(a) 205 (b) 210
(c) 195 (d) 190
(e) None of these

**[Union Bank of India PO, 2011]**

**161.** 15 21 39 77 143 (?)

(a) 243 (b) 240
(c) 253 (d) 245
(e) None of these

**[Corporation Bank PO, 2011]**

**162.** 33 39 57 87 129 (?)

(a) 183 (b) 177
(c) 189 (d) 199
(e) None of these

**[Corporation Bank PO, 2011]**

**163.** 15 19 83 119 631 (?)

(a) 731 (b) 693
(c) 712 (d) 683
(e) None of these

**[Corporation Bank PO, 2011]**

**164.** 19 26 40 68 124 (?)

(a) 246 (b) 238
(c) 236 (d) 256
(e) None of these

**[Corporation Bank PO, 2011]**

**165.** 43 69 58 84 73 (?)

(a) 62 (b) 98
(c) 109 (d) 63
(e) None of these

**[Corporation Bank PO, 2011]**

**166.** 2.5 4 ? 10 14.5 20 26.5

(a) 8 (b) 7.5
(c) 6 (d) 5.5
(e) None of these

**[Rajasthan Grameen Bank PO, 2011]**

**167.** 4 5 12 39 160 805 ?

(a) 4836 (b) 3224
(c) 5642 (d) 4030
(e) None of these

**[Rajasthan Grameen Bank PO, 2011]**

**168.** 8 108 189 253 302 ? 363
(a) 351 (b) 327
(c) 338 (d) 311
(e) None of these
**[Rajasthan Grameen Bank PO, 2011]**

**169.** 248 217 188 165 ? 129 116
(a) 144 (b) 136
(c) 134 (d) 146
(e) None of these
**[Rajasthan Grameen Bank PO, 2011]**

**170.** 3 15 39 75 123 183 ?
(a) 255 (b) 218
(c) 243 (d) 225
(e) None of these
**[Rajasthan Grameen Bank PO, 2011]**

**171.** 1 7 49 343 (?)
(a) 16807 (b) 1227
(c) 2058 (d) 2401
(e) None of these
**[Bank of Baroda PO Examination, 2011]**

**172.** 13 20 39 78 145 (?)
(a) 234 (b) 244
(c) 236 (d) 248
(e) None of these
**[Bank of Baroda PO Examination, 2011]**

**173.** 12 35 81 173 357 (?)
(a) 725 (b) 715
(c) 726 (d) 736
(e) None of these
**[Bank of Baroda PO Examination, 2011]**

**174.** 3 100 297 594 991 (?)
(a) 1489 (b) 1479
(c) 1478 (d) 1498
(e) None of these
**[Bank of Baroda PO Examination, 2011]**

**175.** 112 119 140 175 224 (?)
(a) 277 (b) 276
(c) 287 (d) 266
(e) None of these
**[Bank of Baroda PO Examination, 2011]**

**176.** 4 10 40 190 940 ? 23440
(a) 4690 (b) 2930
(c) 5140 (d) 3680
(e) None of these
**[Bank of India PO, 2010]**

**177.** 4000 2008 1012 ? 265 140.5 78.25
(a) 506 (b) 514
(c) 520 (d) 512
(e) None of these
**[Bank of India PO, 2010]**

**178.** 7 4 5 9 ? 52.5 160.5
(a) 32 (b) 16
(c) 14 (d) 20
(e) None of these
**[Bank of India PO, 2010]**

**179.** 5 54 90 115 131 140 ?
(a) 149 (b) 146
(c) 142 (d) 152
(e) None of these
**[Bank of India PO, 2010]**

**180.** 6 42 ? 1260 5040 15120 30240
(a) 546 (b) 424
(c) 252 (d) 328
(e) None of these
**[Bank of India PO, 2010]**

**181.** 13 16 22 33 51 (?)
(a) 89 (b) 78
(c) 102 (d) 69
(e) None of these
**[Bank of Baroda PO, 2010]**

**182.** 39 52 78 117 169 (?)
(a) 246 (b) 182
(c) 234 (d) 256
(e) None of these
**[Bank of Baroda PO, 2010]**

**183.** 656 432 320 264 236 (?)
(a) 222 (b) 229
(c) 232 (d) 223
(e) None of these
**[Bank of Baroda PO, 2010]**

**184.** 62 87 187 412 812 (?)
(a) 1012 (b) 1437
(c) 1337 (d) 1457
(e) None of these
**[Bank of Baroda PO, 2010]**

**185.** 7 8 24 105 361 (?)
(a) 986 (b) 617
(c) 486 (d) 1657
(e) None of these
**[Bank of Baroda PO, 2010]**

**186.** 9 62 ? 1854 7415 22244

(a) 433 (b) 309
(c) 406 (d) 371
(e) None of these

**[IDBI PO, 2009]**

**187.** 4 8 24 60 ? 224

(a) 178 (b) 96
(c) 109 (d) 141
(e) None of these

**[IDBI PO, 2009]**

**188.** 8000 1600 320 64 12.8 ?

(a) 2.56 (b) 3.5
(c) 3.2 (d) 2.98
(e) None of these

**[IDBI PO, 2009]**

**189.** 6 9 15 27 51 ?

(a) 84 (b) 99
(c) 123 (d) 75
(e) None of these

**[IDBI PO, 2009]**

**190.** 7 8 18 ? 232 1165

(a) 84 (b) 42
(c) 57 (d) 36
(e) None of these

**[IDBI PO, 2009]**

**191.** 9 19 40 83 ? 345 696

(a) 162 (b) 170
(c) 175 (d) 166
(e) None of these

**[Syndicate Bank PO, 2010]**

**192.** The odd term in the sequence 0, 7, 26, 63, 124, 217 is:

(a) 217 (b) 7
(c) 26 (d) 63

**[SSC, 2013]**

**193.** Insert the missing number

3, 18, 12, 72, 66, 396, ?

(a) 300 (b) 380
(c) 350 (d) 390

**[SSC, 2012]**

**194.** The missing term in the sequence 2,3,5,7,11,__,17,19 is:

(a) 16 (b) 1
(c) 14 (d) 13

**[SSC, 2010]**

**195.** The wrong number in the sequence 8, 13, 21, 32, 47, 63, 83 is:

(a) 32 (b) 47
(c) 63 (d) 83

**[SSC, 2010]**

**Directions (Q. 196–200):** In the following number series, only one number is wrong. Find out the wrong number.

**196.** 41 45 61 97 181 261 405

(a) 181 (b) 97
(c) 261 (d) 61
(e) 45

**[IBPS PO/MT, 2014]**

**197.** 16 30 58 114 226 496 898

(a) 58 (b) 226
(c) 30 (d) 114
(e) 496

**[IBPS PO/MT, 2014]**

**198.** 15 21.5 46.5 145 585.5 2933 17603.5

(a) 585.5 (b) 2933
(c) 46.5 (d) 145
(e) 21.5

**[IBPS PO/MT, 2014]**

**199.** 5 6 16 57 246 1245 7506

(a) 16 (b) 6
(c) 1245 (d) 246
(e) 57

**[IBPS PO/MT, 2014]**

**200.** 2 13 46 145 452 1333 4006

(a) 1333 (b) 452
(c) 46 (d) 145
(e) 13

**[IBPS PO/MT, 2014]**

**Directions (Q. 201–205):** In each of these questions a number series is given. In each series only one number is wrong. Find out the wrong number.

**201.** 5531 5506 5425 5304 5135 4910 4621

(a) 5531 (b) 5425
(c) 4621 (d) 5135
(e) 5506

**[IBPS PO/MT, 2012]**

**202.** 6 7 9 13 26 37 69

(a) 7 (b) 26
(c) 69 (d) 37
(e) 9

**[IBPS PO/MT, 2012]**

**203.** 1 3 10 36 152 760 4632

(a) 3 (b) 36
(c) 4632 (d) 760
(e) 152

**[IBPS PO/MT, 2012]**

**204.** 4 3 9 34 96 219 435

(a) 4 (b) 9
(c) 34 (d) 435
(e) 219

**[IBPS PO/MT, 2012] (23)**

**205.** 157.5 45 15 6 3 2 1

(a) 1 (b) 2
(c) 6 (d) 157.5
(e) 45

**[IBPS PO/MT, 2012]**

**Directions (Q. 206–210):** In the following number series only one number is wrong. Find out the wrong number.

**206.** 7 12 40 222 1742 17390 208608

(a) 7 (b) 12
(c) 40 (d) 1742
(e) 208608

**[IBPS PO/MT, 2011]**

**207.** 6 91 584 2935 11756 35277 70558

(a) 91 (b) 70558
(c) 584 (d) 2935
(e) 35277

**[IBPS PO/MT, 2011]**

**208.** 9050 5675 3478 2147 1418 1077 950

(a) 3478 (b) 1418
(c) 5675 (d) 2147
(e) 1077

**[IBPS PO/MT, 2011]**

**209.** 1 4 25 256 3125 46656 823543

(a) 3125 (b) 823543
(c) 46656 (d) 25
(e) 256

**[IBPS PO/MT, 2011]**

**210.** 8424 4212 2106 1051 526.5 263.25 131.625

(a) 131.625 (b) 1051
(c) 4212 (d) 8424
(e) 263.25

**[IBPS PO/MT, 2011]**

**Directions(Q.211–115):** In each of these questions, a number series is given. In each series, only one number is wrong. Find out the wrong number.

**211.** 3601 3602 1803 604 154 36 12

(a) 3602 (b) 1803
(c) 604 (d) 154
(e) 36

**[SBI Associates Banks PO, 2011]**

**212.** 4 12 42 196 1005 6066 42511

(a) 12 (b) 42
(c) 1005 (d) 196
(e) 6066

**[SBI Associates Banks PO, 2011]**

**213.** 2 8 12 20 30 42 56

(a) 8 (b) 42
(c) 30 (d) 20
(e) 12

**[SBI Associates Banks PO, 2011]**

**214.** 32 16 24 65 210 945 5197.5

(a) 945 (b) 16
(c) 24 (d) 210
(e) 65

**[SBI Associates Banks PO, 2011]**

**215.** 7 13 25 49 97 194 385

(a) 13 (b) 49
(c) 97 (d) 194
(5) 25

**[SBI Associates Banks PO, 2011]**

**Directions (Q. 216–220):** What will come in place of the question mark (?) in the following number series?

**216.** 8 10 18 44 124 (?)

(a) 344 (b) 366
(c) 354 (d) 356
(e) None of these

**[IOB PO, 2011]**

**217.** 13 25 61 121 205 (?)

(a) 323 (b) 326
(c) 324 (d) 313
(e) None of these

**[IOB PO, 2011]**

**218.** 656 352 200 124 86 (?)

(a) 67 (b) 59
(c) 62 (d) 57
(e) None of these

**[IOB PO, 2011]**

**219.** 454 472 445 463 436 (?)

(a) 436 (b) 456
(c) 454 (d) 434
(e) None of these

**[IOB PO, 2011]**

**220.** 12 18 36 102 360 (?)

(a) 1364 (b) 1386
(c) 1384 (d) 1376
(e) None of these

**[IOB PO, 2011]**

**Directions (Q. 221–225):** What should come in place of question mark (?) in the following number series?

**221.** 32 49 83 151 287 559 ?

(a) 1118 (b) 979
(c) 1103 (d) 1120
(e) None of these

**[Andhra Bank PO, 2011]**

**222.** 462 552 650 756 870 992 ?

(a) 1040 (b) 1122
(c) 1132 (d) 1050
(e) None of these

**[Andhra Bank PO, 2011]**

**223.** 15 18 16 19 17 20 ?

(a) 23 (b) 22
(c) 16 (d) 18
(e) None of these

**[Andhra Bank PO, 2011]**

**224.** 1050 420 168 67.2 26.88 10.752 ?

(a) 4.3008 (b) 6.5038
(c) 4.4015 (d) 5.6002
(e) None of these

**[Andhra Bank PO, 2011]**

**225.** 0 6 24 60 120 210 ?

(a) 343 (b) 280
(c) 335 (d) 295
(e) None of these

**[Andhra Bank PO, 2011]**

**Directions (Q. 226–230):** In each question below, a number series is given in which one number is wrong. Find out the wrong number.

**226.** 484 240 120 57 26.5 11.25 3.625

(a) 240 (b) 120
(c) 57 (d) 26.5
(e) 11.25

**[Allahabad Bank Po, 2010]**

**227.** 3 5 13 43 176 891 5353

(a) 5 (b) 13
(c) 43 (d) 176
(e) 891

**[Allahabad Bank Po, 2010]**

**228.** 6 7 16 41 90 154 292

(a) 7 (b) 16
(c) 41 (d) 90
(e) 154

**[Allahabad Bank Po, 2010]**

**229.** 5 7 16 57 244 1245 7506

(a) 7 (b) 16
(c) 57 (d) 244
(e) 1245 **[Allahabad Bank Po, 2010]**

**230.** 4 2.5 3.5 6.5 15.5 41.25 126.75

(a) 2.5 (b) 3.5
(c) 6.5 (d) 15.5
(e) 41.25

**[Allahabad Bank Po, 2010]**

**Directions (Q. 231–235):** In the following number series only one number is wrong. Find out the wrong number.

**231.** 2 10 18 54 162 486 1458

(a) 18 (b) 54
(c) 162 (d) 10
(e) None of these

**[Indian Bank PO, 2010]**

**232.** 13 25 40 57 79 103 130

(a) 25 (b) 40
(c) 57 (d) 79
(e) None of these

**[Indian Bank PO, 2010]**

**233.** 850 600 550 500 475 462.5 456.25

(a) 600 (b) 550
(c) 500 (d) 4625
(e) None of these

**[Indian Bank PO, 2010]**

**234.** 142 119 100 83 65 49 42

(a) 65 (b) 100
(c) 59 (d) 119
(e) None of these

**[Indian Bank PO, 2010]**

**235.** 8 12 24 46 72 108 216

(a) 12 (b) 24
(c) 46 (d) 72
(e) None of these

**[Indian Bank PO, 2010]**

**236.** What is the ratio of the marks scored by E in Science and that in Hindi?

(a) 35:83 (b) 61.75
(c) 83:35 (d) 75:61
(e) None of these **[Indian Bank PO, 2010]**

**237.** If a minimum of 101 marks in Science subjects is required for opting science stream in the next academic year, how many students will not be able to opt science stream due to insufficient marks in Science subject?

(a) None (b) 2
(c) 4 (d) 5
(e) 3

**[Indian Bank PO, 2010]**

**238.** What is the total marks obtained by D in Hindi, E in Social Studies and C in Mathematics together?

(a) 258 (b) 244
(c) 235 (d) 210
(e) None of these

**[Indian Bank PO, 2010]**

**Directions (Q. 239–243):** What should come in place of the question mark (?) in the following number series?

**239.** 9 62 ? 1854 7415 22244

(a) 433 (b) 309
(c) 406 (d) 371
(e) None of these

**[IDBI Bank PO, 2009]**

**240.** 4 8 24 60 ? 224

(a) 178 (b) 96
(c) 109 (d) 141
(e) None of these

**[IDBI Bank PO, 2009]**

**241.** 8000 1600 320 64 12.8 ?

(a) 2.56 (b) 3.5
(c) 3.2 (d) 2.98
(e) None of these

**[IDBI Bank PO, 2009]**

**242.** 6 9 15 27 51 ?

(a) 84 (b) 99
(c) 123 (d) 75
(e) None of these

**[IDBI Bank PO, 2009]**

**243.** 7 8 18 ? 232 1165

(a) 84 (b) 42
(c) 57 (d) 36
(e) None of these **[IDBI Bank PO, 2009]**

**Directions (Q. 244–248):** In the following number series only one number is wrong. Find out the wrong number.

**244.** 11 18 29 42 59 80 101

(a) 42 (b) 18
(c) 29 (d) 59
(e) None of these **[OBC PO, 2009]**

**245.** 2 9 32 105 436 2195 13182

(a) 436 (b) 2195
(c) 9 (d) 32
(e) None of these

**[OBC PO, 2009]**

**246.** 5 55 495 3465 17325 34650 51975

(a) 495 (b) 34650
(c) 55 (d) 17325
(e) None of these

**[OBC PO, 2009]**

**247.** 3 7 16 32 56 93 142

(a) 56 (b) 16
(c) 32 (d) 7
(e) None of these

**[OBC PO, 2009]**

**248.** 4 5 12 38 160 805 4836

(a) 12 (b) 160
(c) 38 (d) 805
(e) None of these

**[OBC PO, 2009]**

**Directions (Q. 249–253):** What should come in place ofthe question mark (?) in the following number series?

**249.** 15 25 40 130 ?

(a) 500 (b) 520
(c) 490 (d) 480
(e) None of these

**[NABARD Bank Officer, 2009]**

**250.** 186 94 48 25 ?

(a) 13.5 (b) 14.8
(c) 12.5 (d) 14
(e) None of these

**[NABARD Bank Officer, 2009]**

**251.** 124 112 176 420 1488 ?

(a) 8568 (b) 7140
(c) 5712 (d) 6150
(e) None of these

**[NABARD Bank Officer, 2009]**

**252.** 384 381 372 345 264 ?

(a) 23 (b) 25
(c) 43 (d) 24
(e) None of these

**[NABARD Bank Officer, 2009]**

**253.** 282 286 302 ? 502

(a)366 (b) 318
(c) 326 (d) 338
(e) None of these

**[NABARD Bank Officer, 2009]**

**Directions (Q. 254–255):** In the following number series, only one number is wrong. Find out the wrong number.

**254.** 8 11 17 47 128 371 1100

(a) 11 (b) 47
(c) 17 (d) 371
(e) 128

**[Corporation Bank PO, 2009]**

**255.** 1 5 13 31 61 125 253

(a) 1 (b) 5
(c) 31 (d) 61
(e) 125

**[Corporation Bank PO, 2009]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (a) | **3.** (d) | **4.** (b) | **5.** (b) | **6.** (c) | **7.** (d) | **8.** (b) | **9.** (d) | **10.** (c) | **11.** (c) | **12.** (c) |
| **13.** (a) | **14.** (c) | **15.** (a) | **16.** (c) | **17.** (b) | **18.** (b) | **19.** (c) | **20.** (d) | **21.** (a) | **22.** (d) | **23.** (b) | **24.** (d) |
| **25.** (b) | **26.** (c) | **27.** (e) | **28.** (b) | **29.** (b) | **30.** (c) | **31.** (b) | **32.** (b) | **33.** (a) | **34.** (a) | **35.** (b) | **36.** (d) |
| **37.** (b) | **38.** (b) | **39.** (c) | **40.** (e) | **41.** (b) | **42.** (a) | **43.** (d) | **44.** (d) | **45.** (b) | **46.** (b) | **47.** (c) | **48.** (e) |
| **49.** (c) | | | | | | | | | | | |

### Exercise-2

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (b) | **3.** (e) | **4.** (d) | **5.** (a) | **6.** (c) | **7.** (b) | **8.** (e) | **9.** (c) | **10.** (c) | **11** (a) | **12.** (c) |
| **13.** (e) | **14.** (c) | **15.** (e) | **16.** (d) | **17.** (c) | **18.** (d) | **19.** (e) | **20.** (a) | **21.** (d) | **22.** (a) | **23.** (c) | **24.** (e) |
| **25.** (b) | **26.** (e) | **27.** (b) | **28.** (b) | **29.** (d) | **30.** (c) | **31.** (c) | **32.** (c) | **33.** (d) | **34.** (b) | **35.** (d) | **36.** (d) |
| **37.** (c) | **38.** (c) | **39.** (c) | **40.** (c) | **41.** (b) | **42.** (d) | **43.** (d) | **44.** (d) | **45.** (d) | **46.** (a) | **47.** (e) | **48.** (c) |
| **49.** (d) | **50.** (a) | **51.** (a) | **52.** (c) | **53.** (c) | **54.** (d) | **55.** (a) | **56.** (a) | **57.** (d) | **58.** (c) | **59.** (e) | **60.** (b) |
| **61.** (d) | **62.** (e) | **63.** (a) | **64.** (c) | **65.** (a) | **66.** (c) | **67.** (d) | **68.** (e) | **69.** (a) | **70.** (c) | **71.** (e) | **72.** (b) |
| **73.** (c) | **74.** (a) | **75.** (b) | **76.** (b) | **77.** (e) | **78.** (c) | **79.** (c) | **80.** (c) | **81.** (c) | **82.** (d) | **83.** (b) | **84.** (c) |
| **85.** (c) | **86.** (e) | **87.** (c) | **88.** (a) | **89.** (d) | **90.** (b) | **91.** (b) | **92.** (e) | **93.** (d) | **94.** (c) | **95.** (a) | **96.** (e) |
| **97.** (c) | **98.** (a) | **99.** (c) | **100.** (b) | **101.** (e) | **102.** (a) | **103.** (d) | **104.** (b) | **105.** (c) | **106.** (a) | **107.** (c) | 108. (b) |
| **109.** (e) | **110.** (d) | **111.** (a) | **112.** (d) | **113.** (b) | **114.** (e) | **115.** (c) | **116.** (e) | **117.** (d) | **118.** (c) | **119.** (d) | **120.** (b) |
| **121.** (c) | **122.** (a) | **123.** (e) | **124.** (d) | **125.** (b) | **126.** (c) | **127.** (d) | **128.** (a) | **129.** (e) | **130.** (c) | **131.** (e) | **132.** (d) |
| **133.** (c) | **134.** (b) | **135.** (a) | **136.** (e) | **137.** (a) | **138.** (b) | **139.** (e) | **140.** (d) | **141.** (b) | **142.** (a) | **143.** (c) | **144.** (e) |
| **145.** (d) | **146.** (c) | **147.** (b) | **148.** (e) | **149.** (a) | **150.** (b) | **151.** (b) | **152.** (d) | **153.** (d) | **154.** (a) | **155.** (c) | **156.** (e) |
| **157.** (d) | **158.** (d) | **159.** (b) | **160.** (e) | **161.** (e) | **162.** (a) | **163.** (a) | **164.** (c) | **165.** (e) | **166.** (e) | **167.** (a) | **168.** (c) |
| **169.** (d) | **170.** (a) | **171.** (d) | **172.** (d) | **173.** (a) | **174.** (e) | **175.** (c) | **176.** (a) | **177.** (b) | **178.** (d) | **179.** (e) | **180.** (c) |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **181.** (b) | **182.** (c) | **183.** (a) | **184.** (b) | **185.** (a) | **186.** (d) | **187.** (e) | **188.** (a) | **189.** (b) | **190.** (c) | **191** (b) | **192.** (a) |
| **193.** (d) | **194.** (d) | **195.** (b) | **196.** (a) | **197.** (e) | **198.** (e) | **199.** (d) | **200.** (b) | **201.** (a) | **202.** (b) | **203.** (d) | **204.** (d) |
| **205.** (a) | **206.** (d) | **207.** (c) | **208.** (e) | **209.** (d) | **210.** (b) | **211.** (d) | **212.** (b) | **213.** (a) | **214.** (e) | **215.** (d) | **216.** (b) |
| **217.** (d) | **218.** (a) | **219.** (c) | **220.** (b) | **221.** (c) | **222.** (b) | **223.** (d) | **224.** (a) | **225.** (e) | **226.** (b) | **227.** (d) | **228.** (e) |
| **229.** (a) | **230.** (c) | **231.** (d) | **232.** (c) | **233.** (a) | **234.** (a) | **235.** (c) | **236.** (a) | **237.** (e) | **238.** (b) | **239.** (d) | **240.** (e) |
| **241.** (a) | **242.** (b) | **243.** (c) | **244.** (e) | **245.** (d) | **246.** (b) | **247.** (a) | **248.** (c) | **249.** (e) | **250.** (a) | **251.** (b) | **252.** (e) |
| **253.** (d) | **254.** (c) | **255.** (c) | | | | | | | | | |

# EXPLANATORY ANSWERS

## Exercise-1

1. **(b)** $8 - 5 = 3$, $12 - 8 = 4$, $17 - 12 = 5$, $23 - 17 = 6$
   $\therefore\ ? - 23 = 7$
   i.e., $? = 23 + 7 = 30$
   With this, $38 - 30 = 8$.
2. **(a)** The pattern is
   $9 = 2 \times 4 + 1$
   $20 = 2 \times 9 + 2$
   $43 = 2 \times 20 + 3$
   $90 = 2 \times 43 + 4$
   $\therefore$ ? should be $2 \times 90 + 5 = 185$.
3. **(d)** The first alternate series is 1, 4, 9, 16
   i.e., $1^2, 2^2, 3^2, 4^2$ and the second one is
   1, 8, 27, ?
   i.e., $1^3, 2^3, 3^3, 4^3$.
4. **(b)** $2 \times 3 = 6$
   $4 \times 5 = 20$
   $6 \times 7 = 42$.
5. **(b)** $5 - 1 = 4$, $11 - 5 = 6$, $19 - 11 = 8$
   $29 - 19 = 10$
   $\therefore\ ? - 29 = 12$
   $\therefore\ ? = 41$.
6. **(c)** Difference between successive terms are
   3, 15, 7, 27, 11, ? − 66, 120 − ?
   Here, odd places terms form a series
   3, 7, 11, 120 − ?
   which is an A.P. with common difference 4 and even places terms form a series
   15, 27, ? − 66
   $\therefore\ 120 - ? = 11 + 4 = 15$
   $\therefore\ ? = 120 - 15 = 105$.
7. **(d)** $13 = 5 + 4 \times 2$, $25 = 13 + 4 \times 3$, $41 = 25 + 4 \times 4$
   $? = 41 + 4 \times 5$, $85 = ? + 4 \times 6$
   $113 = 85 + 4 \times 7$, $145 = 113 + 4 \times 8$
   $\therefore\ ? = 41 \times 4 \times 5 = 61$. With this choice
   $85 = ? + 4 \times 6$
   $= 61 + 24$, which follows the pattern.
8. **(b)** $5 = 4 + 1^2$, $9 = 5 + 2^2$, $18 = 9 + 3^2$,
   $34 = 18 + 4^2$,
   $\therefore\ ? = 34 + 5^2 = 59$.
9. **(d)** $1799 - 899 = 900$
   $899 - 449 = 450 \left(= \frac{1}{2} \times 900\right)$
   $\therefore\ 449 - ? = \frac{1}{2} \times 450 = 225$
   $\therefore\ ? = 449 - 225 = 224$.
10. **(c)** 1st, 4th, 7th, 10th, and 13th terms are:
    2, 4, 6, 8, ?
    which is an A.P. with common difference 2
    $\therefore\ ? = 8 + 2 = 10$.
11. **(c)** $11 - 5 = 6$, $19 - 11 = 8$, $29 - 19 = 10$
    $\therefore\ ? - 29 = 12$
    $\therefore\ ? = 12 + 29 = 41$.
12. **(c)** 0, 3, 12, 30, ?, 105, 168
    3, 9, 18, ? − 30, 105 − ?, 63
    6, 9, ? − 48, 135 − 2?, ? − 42
    If we take ? − 48 = 12, then ? = 60, with this choice 135 − 2? = 135 − 120 = 15
    and, ? − 42 = 18
    $\therefore$ 3rd row becomes
    6, 9, 12, 15, 18,

which is an A.P. of common difference 3

$\therefore$ ? should be 60.

**13.** **(a)** $20 = 15 + 5 \times 1$;

$30 = 20 + 5 \times 2$

$\therefore$ ? should be $30 + 5 \times 3 = 45$.

**14.** **(c)** 1st, 3rd, 5th, 7th, terms are 1: 11, ?, 1001 10001 and 2nd, 4th, 6th, terms are

2: 10, 100, 1000

In 1:

(1) at first place there is no zero between 1's

(2) at 3rd place there are 2 zeros between 1's

(3) at 4th place there are 3 zeros between 1's

$\therefore$ According to this pattern there should be 1 zero between 1's at 2nd place

$\therefore$ ? be 101.

**15.** **(a)** $99 - 95 = 4 = 2^2$, $95 - 86 = 9 = 3^2$

$86 - 70 = 16 = 4^2$

$\therefore$ $70 - ? = 5^2$

$\therefore$ $70 - 25 = ?$

$\therefore$ $? = 45$.

**16.** **(c)** Numbers at even places form series

1: 18, 12, ?

and numbers at odd places form series

2: 5, 10, 15

Keeping the pattern in 1

? should be $12 - 6 = 6$.

**17.** **(b)** In the first alternate series, namely, 12, 14, 16 each term is increased by 2 and in the second, namely, 8, 6 each term is decreased by 2, missing figure is of 2nd series and hence should by $6 - 2 = 4$.

**18.** **(b)** Making pairs taking first number from right and first from left, 2nd number from right and 2nd number from left and so on.

(13, ?); (21, 12); (29, 92); (34, 43)

In each pair numbers have their digits reversed keeping this pattern, ? should be 31.

**19.** **(c)** $43 = 2^2 - 1$; $15 = 4^2 - 1$; $35 = 6^2 - 1$

$99 = 10^2 - 1$; $143 = 12^2 - 1$

$\therefore$ Missing figure should be $8^2 - 1 = 63$.

**20.** **(d)** The pattern is

$4 + 7 = 11$

$18 + 29 = 47$

$? + 123 = 199$

$\therefore$ $? = 199 - 123 = 76$.

**21.** **(a)** Series formed by numbers at odd and even places respectively are:

455, 465, 485, 475 …(1)

and, 445, 435, 415 …(2)

The difference between successive terms of I are:

10, 20, −10

and of 2 are

−10, − 20

−10 in (1) is abnormal. It should be 30

$\therefore$ 475 is wrong and should be replaced by $485 + 30 = 515$.

**22.** **(d)** $10 = 2 \times 3 + 4$

$24 = 2 \times 10 + 4$

$54 = 2 \times 24 + 6$

$108 = 2 \times 54 + 0$

$220 = 2 \times 108 + 4$

$444 = 2 \times 220 + 4$

Pattern is disturbed at 3rd and 4th stages.

$\therefore$ 54 is wrong and should be replaced by $2 \times 24 + 4 = 52$. With this choice at 4th stage, $108 = 2 \times 52 + 4$ which follows pattern.

**23.** **(b)** $18 = 8 \times 2 + 2 \times 1$; $40 = 18 \times 2 + 2 \times 2$

$86 = 40 \times 2 + 2 \times 3$; $178 \neq 86 \times 2 + 2 \times 4$

$370 \neq 178 \times 2 + 2 \times 5$; $752 = 370 \times 2 + 2 \times 6$

$\therefore$ 178 is wrong and should be replaced by

$2 \times 86 + 2 \times 4 = 180$

With this choice 5th place

$2 \times 180 + 2 \times 5 = 370$

which is according to the pattern.

**24.** **(d)** $2676 = 6 \times 445 + 6$; $445 \neq 5 \times 84 + 5$

$84 \neq 4 \times 21 + 4$; $21 = 3 \times 6 + 3$

$6 = 2 \times 2 + 2$; $2 = 1 \times 1 + 1$

Obviously, 84 is wrong and should be replaced by $4 \times 21 + 4 = 88$

With this, $445 = 5 \times 88 + 5$.

**25.** **(b)** Numbers at even places are

$16 = 4^2$; $64 = 8^2$; $216 \neq 12^2$

and numbers at odd places are

$1 = 1^2$; $9 = 3^2$; $25 = 5^2$; $49 = 7^2$

$\therefore$ 216 is wrong.

**26.** **(c)** $864 = 2 \times 420 + 4 \times 6$; $420 = 2 \times 200 + 4 \times 5$

$200 \neq 2 \times 96 + 4 \times 4$; $96 \neq 2 \times 40 + 4 \times 3$

$40 = 2 \times 16 + 4 \times 2$; $16 = 2 \times 6 + 4 \times 1$

$\therefore$ 96 is wrong and should be replaced by $2 \times 40 + 4 \times 3 = 92$. With this choice at 3rd stage

$200 = 2 \times 92 + 4 \times 4$.

**27.** **(e)** $13 - 9 = 4$; $21 - 13 = 8$; $37 - 21 = 16$

$69 - 37 = 32$; $132 - 69 = 63$; $261 - 132 = 129$

Pattern is disturbed at last 2 stages.

$\therefore$ 132 is wrong and should be replaced by $69 + 64 = 133$. With this choice at last stage

$261 - 133 = 128$.

**28.** **(b)** Series formed by numbers at odd places and even places respectively are

1: 2, 18, 24, 34

2: 5, 19, 29

Successive terms in 1 and 2 have difference

16, 6, 10

and 14, 10, respectively.

Abnormality is at 16. It should be replaced by 2

$\therefore$ 2 is wrong and should be replaced by 16.

**29.** **(b)** $5 - 1 = 4$; $11 - 5 = 6$; $19 - 11 = 8$

$29 - 19 = 10$; $55 - 29 = 26$

Pattern gets disturbed at last stage

$\therefore$ 55 is wrong

It should be $29 + 12 = 41$.

**30.** **(c)** Numbers at odd and even places form respective series

1: 2, 4, 8, 64

i.e., $2^1, 2^2, 2^3, 2^6$

and, 2: 4, 16, 256

i.e., $2^2, 2^4, 2^8$

Obviously, $2^6 = 64$ is wrong and should be replaced by $2^4 = 16$.

**31.** **(b)** If 216 is replaced by 217 the terms of the series will get arranged in the order of

$1 \times (1)^2 + 1, 2 \times (2)^2 + 1, 3 \times (3)^2 + 1, 4 \times (4)^2 + 1$ .... and so on.

Therefore, alternative (b) is the correct answer.

**32.** **(b)** A careful scrutiny of the series reveals that if 50 is replaced by 49, then difference between successive terms will be in the order of 1, 3, 5, 7, 9, 11. Therefore, alternative (b) is the correct answer.

**33.** **(a)** If 169 is replaced by 225 the terms will get arranged in a particular series, that is, $(1^2 - 1)^2$,

$(2^2 - 1)^2, (3^2 - 1)^2, (4^2 - 1)^2, (5^2 - 1)^2$ and $(6^2 - 1)^2$.

Therefore, alternative (a) is the correct answer.

**34.** **(a)** If 7 is replaced by 8 these terms of the series will get arranged in order of

$1 \times 2 + 1, 3 \times 2 + 2, 8 \times 2 + 3,$

$19 \times 2 + 4, 42 \times 2 + 5, 89 \times 2 + 6$

Therefore, alternative (a) is the correct answer.

**35.** **(b)** A careful scrutiny of the series reveals that if 80 is replaced by 81 then the series will be arranged in the order of

$13^2, 11^2, 9^2, 7^2, 5^2, 3^2, 1^2$. Therefore, (b) is the correct alternative.

**36.** **(d)** It is obvious from the given series that if 9 is replaced by 8 then difference between successive terms will be in the order of $1^2, 3^2, 5^2, 7^2, 9^2$ and $11^2$

Therefore, alternative (d) is the correct answer.

**37.** **(b)** If 48 is replaced by 50 each term of the series is obtained by subtracting 2 from twice its previous term. Therefore, alternative (b) is the correct answer.

**38.** **(b)** If 73 is replaced by 75, difference between successive terms of the series will be in the order of 9, 11, 13, 15, 17 and 19.

Therefore, alternative (b) is the correct alternative.

**39.** **(c)** A careful scrutiny of the given series reveals that second term is 2 times the first, third term is 4 times the second and fourth term is 3 times the third. The same pattern is being followed by the remaining terms of the series. Therefore, 2688 should be replaced by 4032. Hence, alternative (c) is the correct alternative.

**40.** **(e)** If 15 is replaced by 13 the difference between successive terms will be in the order of 2, 4, 2, 4, .... and so on. Therefore, alternative (e) is the correct alternative.

**41.** **(b)** The pattern followed by the numbers of the given series is:

$9 = 8 \times 1 + 1$; $65 = 7 \times 9 + 2$

$393 = 6 \times 65 + 3$

$\therefore$ (A) $= 8 \times 2 + 1 = 17$

(B) $= 7 \times 17 + 2 = 121$

(C) $= 6 \times 121 + 3 = 729$

(D) $= 5 \times 729 + 4 = 3649$

(E) $= 4 \times 3649 + 5 = 14601$.

**42.** **(a)** The pattern is

$616 - 496 = 120 = 12 \times 10$

$469 - 397 = 99 = 11 \times 9$

$397 - 317 = 80 = 10 \times 8$

$317 - 254 = 63 = 9 \times 7$

$\therefore$ (A) $= 838 - 120 = 718$

(B) $= 718 - 99 = 619$

(C) $= 619 - 80 = 539$

(D) $= 539 - 63 = 476$

(E) $= 476 - 48$ ($= 8 \times 6$) $= 428$.

**43.** **(d)** $434 - 353 = 9^2$

$353 - 417 = 8^2$

$417 - 368 = 7^2$

$368 - 404 = 6^2$

$404 - 379 = 5^2$

$\therefore$ $108 - (A) = 9^2 \Rightarrow (A) = 108 - 81 = 27$

$27 - (B) = -8^2 \Rightarrow (B) = 27 + 64 = 91$

$91 - (C) = 7^2 \Rightarrow (C) = 91 - 49 = 42$

$42 - (D) = -6^2 \Rightarrow (D) = 42 + 36 = 78$

$78 - (E) = 5^2 \Rightarrow (E) = 78 - 25 = 53$.

**44.** **(d)** The rule followed is:

$272 = 2 \times 120 + 8 \times 4$

$120 = 2 \times 48 + 8 \times 3$

$48 = 2 \times 16 + 8 \times 2$

$16 = 2 \times 4 + 8 \times 1$

$\therefore$ (A) $= 2 \times 124 + 8 \times 1 = 256$

(B) $= 2 \times 256 + 8 \times 2 = 528$

(C) $= 2 \times 528 + 8 \times 3 = 1080$

(D) $= 2 \times 1080 + 8 \times 4 = 2192$

(E) $= 2 \times 2192 + 8 \times 5 = 4424$.

**45.** **(b)** The pattern followed by the numbers of given series is:

$9 = 8 \times 1 + 1$; $65 = 7 \times 9 + 2$; $393 = 6 \times 65 + 3$

$\therefore$ (A) $= 8 \times 2 + 1 = 17$

(B) $= 7 \times 17 + 2 = 121$

(C) $= 6 \times 121 + 3 = 729$

(D) $= 5 \times 729 + 4 = 3649$

(E) $= 4 \times 3649 + 5 = 14601$.

**46.** **(b)** $848 = 2 \times 420 + 8$ $\quad\therefore$ (A) $= \dfrac{664-8}{2} = 328$

$420 = 2 \times 206 + 8$ $\quad$ (B) $= \dfrac{328-8}{2} = 160$

$206 = 2 \times 99 + 8$ $\quad$ (C) $= \dfrac{160-8}{2} = 76$

$99 = 2 \times 45.5 + 8$ $\quad$ (D) $= \dfrac{76-8}{2} = 34$

(E) $= \dfrac{34-8}{2} = 13$.

**47.** **(c)** The rule is

$8 = \dfrac{8}{2} \times 2$ $\quad\therefore$ (A) $= \dfrac{36}{2} \times 2 = 36$

$12 = \dfrac{8}{2} \times 3$ $\quad$ (B) $= \dfrac{36}{2} \times 3 = 54$

$24 = \dfrac{12}{2} \times 4$ $\quad$ (C) $= \dfrac{54}{2} \times 4 = 108$

(D) $= \dfrac{108}{2} \times 5 = 270$

(E) $= \dfrac{270}{2} \times 6 = 810$.

**48.** **(e)** $449 = 4 \times 111 + 5$ $\therefore$

$111 = 3 \times 35 + 6$

$35 = 2 \times 14 + 7$

$14 = 1 \times 6 + 8$

(A) $= 1 \times 3 + 8 = 11$

(B) $= 2 \times 11 + 7 = 29$

(C) $= 3 \times 29 \times 6 = 93$

(D) $= 4 \times 93 \times 5 = 377$

(E) $= 5 \times 377 + 4 = 1889$.

**49.** **(c)** The pattern is

$5736 = 4 \times 1435 - 4$

$1435 = 5 \times 288 - 5$

$288 = 6 \times 49 - 6$

$49 = 7 \times 8 - 7$

$\therefore$ (A) $= 7 \times 5 - 7 = 28$

(B) $= 6 \times 28 - 6 = 162$

(C) $= 5 \times 162 - 5 = 805$

(D) $= 4 \times 805 - 4 = 3216$

(E) $= 3 \times 3216 - 3 = 9645$.

## EXERCISE-2
## (BASED ON MEMORY)

**1.** **(c)** The sequence in the given series is + 2, + 6, + 10, + 14, + 18

**2.** **(b)** Series 1: 2, 2 + 8 = 10, 10 + 8 = 18, 18 + 8 = 26, 26 + 8 = 34

Series 2: 5, 5 + 9 = 14, 14 + 9 = 23, 23 + 9 = 32

**3.** **(e)** 7413, 7413 + 9 = 7422, 7422 + 18 = 7440, 7440 + 27 = 7467, 7467 + 36 = 7503, 7503 + 45 = 7548

**4.** **(d)**

| 4 | 16 | 36 | 64 | 100 | 144 |
|---|---|---|---|---|---|
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| $(2)^2$ | $(4)^2$ | $(6)^2$ | $(8)^2$ | $(10)^2$ | $(12)^2$ |

**5.** **(a)** 12, 12 × 3 − 3 = 33, 33 × 3 − 3 = 96, 96 × 3 − 3 = 285, 285 × 3 − 3 = 852, 852 × 3 − 3 = 2553

**6.** **(c)** 70000, 70000 ÷ 5 = 14000, 14000 ÷ 5 = 2800, 2800 ÷ 5 = 560, 560 ÷ 5 = 112, 112 ÷ 5 = 22.4

**7.** **(b)**

$$\overbrace{99,\ 104,\ 97}^{-2},\ \overbrace{106,\ 95\ \boxed{\phantom{00}}}^{-2}$$

$$\underbrace{102,\ 99,\ 104}_{+2},\ \underbrace{97,\ 106}_{+2},\ 95\ \boxed{\phantom{00}}$$

**8.** **(e)** 14 × 3 + 1.5 = 43.5, 43.5 × 6 + 3 = 264, 264 × 12 + 6 = 3174, 3174 × 24 + 12 = 76188

**9.** **(c)** The series is: $41 \times 2^2 = 164$, $164 \times 4^2 = 2624$, $2624 \times 6^2 = 94464$, $94464 \times 8^2 = 6045696$

**10.** **(c)** 32 + 17 = 49, 49 + 34 = 83, 83 + 68 = 151, 151 + 136 = 287, 287 + 272 = 559, 559 + 544 = 1103

**11.** **(a)** 12 + 2 = 14, 14 + 3 = 17, 17 − 4 = 13, 13 − 5 = 8, 8 + 6 = 14, 14 + 7 = 21, 21 − 8 + 13, 13 − 9 = 4, 4 + 10 = 14

**12.** **(c)** 4 × 1.5 = 6, 6 × 2 = 12, 12 × 2.5 = 30, 30 × 3 = 90, 90 × 3.5 = 315, 315 × 4 = 1260

**13.** **(e)** 25 16 ? 4 1

i.e., $5^2$ $4^2$ $3^2$ $2^2$ $1^2$

Hence, ? = 9

**14.** **(c)** 15 − 3 = 12, 12 + 5 = 17, 17 − 7 = 10, 10 + 11 = 21, 21 − 13 = 8, 8 + 17 = 25, 25 − 19 = 6

Note that 3, 5, 7, 11, 13, 17 and 19 are consecutive prime numbers.

**15.** **(e)** The series is: (× 2) − 1

$\therefore$ ? = 113 × 2 − 1 = 225

**16.** **(d)** The series is +5, +10, +15, +20, +25

So, 45 is wrong. It should be 47

**17.** **(c)** The series is:

$\times 1 + 1, \times 2 + 2, \times 3 + 3, \times 4 + 4, \times 5 + 5, \times 6 + 6$

34 should be 33 and thus the new series starts with 34.

**18.** **(d)** The series is

$-(14)^2, +(12)^2, -(10)^2, +(8)^2, -(16)^2$ and so on. 143 should be 126 and thus the new series starts with 143.

**19.** **(e)** The series is

$\times \frac{1}{2}, \times \frac{3}{2}, \times \frac{5}{2}, \times \frac{7}{2}, \times \frac{9}{2}, \times \frac{11}{2}$ and so on.

So, 180 is incorrect.

**20.** **(a)** The series is $+1^2 - 0, +2^2 - 1, +3^2 - 2, +4^2 - 3, +5^2 - 4, +6^2 - 5$.

So, 7 is incorrect.

**21.** **(d)** The series is $\times 8 + 1, \times 7 + 2, \times 6 + 3$,

$\therefore \quad a = 2 \times 8 + 1 = 17, b = 17 \times 7 + 2 = 121$

$c = 121 \times 6 + 3 = 729$.

**22.** **(a)** The series is $\times 1, \times 1.5, \times 2$

$\therefore \quad a = 36 \times 1 = 36, b = 36 \times 1.5 = 54, c = 54 \times 2 = 108, d = 108 \times 2.5 = 270, e = 270 \times 3 = 810$.

**23.** **(c)** The series is $\div 2 - 4$

$\therefore \quad a = 888 \div 2 - 4 = 440$

and, $b = 440 \div 2 - 4 = 216$.

**24.** **(e)** The series is $\times 1 + 1, \times 1.5 + 2.25, \times 2 + 4, \times 2.5 + 6.25, \times 3 + 9, \ldots$

$\therefore \quad a = 7 \times 1 + 1 = 8$,

$b = 8 \times 1.5 + 2.25 = 14.25$

$c = 14.25 \times 2 + 4 = 32.5$,

$d = 32.5 \times 2.5 + 6.25 = 81.25 + 6.25 = 87.25$.

**25.** **(b)** The series is

$+(17)^2, -(15)^2, +(13)^2, -(11)^2, +(9)^2$

$\therefore \quad a = 13 + (17)^2 = 302$

$b = 302 - (15)^2 = 302 - 225 = 77$

$c = 77 + (13)^2 = 77 + 169 = 246$

$d = 246 - (11)^2 = 246 - 121 = 125$

$e = 125 + (9)^2 = 125 + 81 = 206$.

**26.** **(e)** The series is $\times 1 + 1, \times 2 + 2, \times 3 + 3, \ldots$ So 8 is wrong.

Beginning with 8 we get 20 as third term.

**27.** **(b)** The series is $\times 1 + 1^2, \times 2 + 2^2, \times 3 + 3^2, \ldots$

So, 265 is incorrect.

**28.** **(b)** The series is $\times 2 + 9, \times 2 + 11, \times 2 + 13, \ldots$

So, 58 is incorrect.

**29.** **(d)** The series is

$\times 3 + 1, \times 4 + 1, \times 5 + 1, \ldots$

So, 28 is incorrect.

**30.** **(c)** The series is

$\times 1 + 1^2, \times 2 + 2^2, \times 3 + 3^2, \times 4 + 4^2 \ldots$

So, 6 is incorrect.

**31.** **(c)**

7 9 13 21 37 69

+2 +4 +8 +16 +32

×2 ×2 ×2 ×2

**32.** **(c)**

36 28 24 22 21

− 8 − 4 − 2 − 1

**33.** **(d)**

0 4 18 45 100 180

+4 +14 +30 +52 +80

+10 +16 +22 +28

+6 +6 +6

**34.** **(b)**

$$\begin{array}{ccc} 9 & 8 & 7 \\ \downarrow & \downarrow & \downarrow \\ I & H & G \end{array}$$

Likewise,

$$\begin{array}{ccc} 6 & 5 & 4 \\ \downarrow & \downarrow & \downarrow \\ F & E & D \end{array}$$

**35.** **(d)** $5^2 - 1 = 24; 5^3 + 1 = 126$ ::

$7^2 - 1 = 48; 7^3 + 1 = 344$

**36.** **(d)** $(1)^3 = 1; (2)^3 = 8$ ::

$(3)^3 = 27; (4)^3 = 64$

**37.** **(c)**

27

6 9 15 22 51 99

+3 +6 +12 +24 +48

$\therefore \quad$ 22 should be replaced by 27.

**38.** **(c)** $8 \xrightarrow{+7} 15 \xrightarrow{+21} 36 \xrightarrow{+63}$

$99 \xrightarrow{+189} 288 \xrightarrow{+567} 855$

The difference between the consecutive term keeps on multiplying by 3.

**39.** **(c)** $2^2 = 4, 4^2 = 16, 8^2 = 64$

Consider the alternative term

$2^2 = 4, 4^2 = 16, ? = ?, 8^2 = 64$

Hence, ? has to be replaced by $(6)^2 = 36$

**40.** **(c)** 6 – 5 = 1

8 – ? = 2

–? = 2 – 8

–? = – 6

∴ ? = 6

**41.** **(b)** 5, 21, 69, 213, 645

21 – 5 = 16

∴ 16 × 3 = 48

69 – 21 = 48

and 48 × 3 = 144

213 – 69 = 144

∴ 144 × 3 = 432

645 – 213 = 432

432 × 3 = 1296

Likewise,

? – 645 = 1296

∴ ? = 1296 + 645

? = 1941

**42.** **(d)** 11 × 11 = 121

12 × 12 = 144

Difference = 17 – 12 = 5

17 × 17 = 289

18 × 18 = 324

Difference = 23 – 18 = 5

23 × 23 = 529

24 × 24 = 576

Likewise,

? – 24 = 5

? = 29

Hence, 29 × 29 = 729

**43.** **(d)** 19 – 14 = 5

29 – 19 = 10

49 – 29 = 20

89 – 49 = 40

Likewise,

? – 89 = 80

? = 80 + 89

? = 169

**44.** **(d)** 34, 18, 10, ?

$$\left.\begin{aligned} 34-18&=16\\ 18-10&=8\\ 10-?&=4 \end{aligned}\right\} \begin{aligned} 16\div 2&=8\\ 8\div 2&=4 \end{aligned}$$

Therefore, – ? = 4 – 10

⇒ = ? = –6

⇒ ? = 6

**45.** **(d)**

9 8 10 16 11 32 12 64

$$8 \xrightarrow{\times 2} 16 \xrightarrow{\times 2} 32 \xrightarrow{\times 2} 64$$

$$9 \xrightarrow{+1} 10 \xrightarrow{+1} 11 \xrightarrow{+1} 12$$

**46.** **(a)**

$$7 \xrightarrow{\times 1+1} 8 \xrightarrow{\times 2+2} 18 \xrightarrow{\times 3+3} 57 \xrightarrow{\times 4+4} ?\ \boxed{232}$$

**47.** **(e)**

$$7 \xrightarrow{+4} 11 \xrightarrow{+8} 19 \xrightarrow{+16} 35 \xrightarrow{+32} ?\ \boxed{67}$$

**48.** **(c)**

$$5 \xrightarrow{\times 2+1} 11 \xrightarrow{\times 2+1} 23 \xrightarrow{\times 2+1} ?\ \boxed{47} \xrightarrow{\times 2+1} 95$$

**49.** **(d)**

$$17 \xrightarrow{\times 1+5} 22 \xrightarrow{\times 2+8} 52 \xrightarrow{\times 3+9} 165 \xrightarrow{\times 4+8} ?\ \boxed{668}$$

$$\times 1+5 \xrightarrow{+3} \times 2+8 \xrightarrow{+1} \times 3+9 \xrightarrow{-1} \times 4+8$$

$$+3 \xrightarrow{-2} +1 \xrightarrow{-2} -1$$

**50.** **(a)**

$$2 \xrightarrow{\times 3} 6 \xrightarrow{\times 5} 30 \xrightarrow{\times 7} 210 \xrightarrow{\times 11} \boxed{2310} \xrightarrow{\times 13} 30030$$

**51.** **(a)**

$$142 \xrightarrow{-23} 119 \xrightarrow{-19} 100 \xrightarrow{-17} 83 \xrightarrow{-13} \overset{\boxed{70}}{65} \xrightarrow{-11} 59 \xrightarrow{-7} 52$$

So, wrong number = 65

Correct number = 83 – 13 = 70

**52.** **(c)**

36

8 12 24 46 72 108 216

×1.5 ×2 ×1.5 ×2 ×1.5 ×2

So, wrong number = 46

Correct number = 24 × 1.5 = 36

**53.** **(c)**

58

13 25 40 57 79 103 130

+12 +15 +18 +21 +24 +27

So, wrong number = 57

Correct number = 40 + 18 = 58

**54.** **(d)**

6

2 10 18 54 162 486 1458

×3 ×3 ×3 ×3 ×3 ×3

So, wrong number = 10

Correct number = 2 × 3 = 6

**55.** **(a)**

650

850 600 550 500 475 462.5 456.25

–200 –100 –50 –25 –12.5 –6.25

So, wrong number = 600

Correct number = 850 – 200 = 650

**56.** **(a)**

945

12 12 18 36 90 270 ?

×1 ×1.5 ×2 ×2.5 ×3 ×3.5

**57.** **(d)**

35.75

1015 508 255 129 66.5 ? 20.875

÷2+.5 ÷2+1 ÷2+1.5 ÷2+2 ÷2+2.5 ÷2+3

**58.** **(c)**

7716

8 9 20 63 256 1285 ?

×1+1 ×2+2 ×3+3 ×4+4 ×5+5 ×6+6

**59.** **(e)**

19

980 484 236 112 50 ? 3.5

÷2–6 ÷2–6 ÷2–6 ÷2–6 ÷2–6 ÷2–6

**60.** **(b)**

118

484 240 120 57 26.5 11.25 3.625

÷2 –2 ÷2 –2 ÷2 –2 ÷2 –2 ÷2 –2 ÷2 –2

Hence, wrong number is 120.

**61.** **(d)**

177

3 5 13 43 176 891 5353

×1 + 2 ×2 + 3 ×3 + 4 ×4 + 5 ×5 + 6 ×6 + 7

Hence, wrong number is 176.

**62.** **(e)**

171

6 7 16 41 90 154 292

$+1^2$ $+3^2$ $+5^2$ $+7^2$ $+9^2$ $+11^2$

Hence, wrong number is 154.

**63.** **(a)**

6

5 7 16 57 244 1245 7506

$\times1 +1^2$ $\times2 +2^2$ $\times3 +3^2$ $\times4 +4^2$ $\times5 +5^2$ $\times6 +6^2$

Hence, wrong number is 7.

**64.** **(c)**

6.75

4 2.5 3.5 6.5 15.5 41.25 126.75

$\times\frac{1}{2}+\frac{1}{2}$ ×1 +1 $\times\frac{3}{2}+\frac{3}{2}$ ×2 +2 $\times\frac{5}{2}+\frac{5}{2}$ ×3 +3

Hence, wrong number is 6.5.

**65.** **(a)**

33

34

32 34 37 46 62 87 123

$+1^2$ $+2^2$ $+3^2$ $+4^2$ $+5^2$ $+6^2$

So, the wrong number is 34 which must be 33.

**66.** **(c)**

51

40

7 18 40 106 183 282 403

+1 × 11 +3 × 11 +5 × 11 +7 × 11 +9 × 11 +11 × 11

So, the wrong number is 40 which must be 51.

**67.** **(d)**

780

850 843 829 808 788 745 703

–7 –14 –21 –28 –35 –42

So, the wrong number is 788 which must be 780.

**68.** **(e)**

591

33 321 465 537 573 590 600

+288 +144 +72 +36 +18 +9

So, the wrong number is 590 which must be 591.

**69.** **(a)**

42

37 47 52 67 87 112 142

+5 +10 +15 +20 +25 +30

So, the wrong number is 47 which must be 42.

**70.** **(c)**

586 587 586 581 570 551 522

×0.5 ×1 ×1.5 ×2 ×2.5 ×3

+1 –1 –5 –11 –19 –29

–2 –4 –6 –8 –10

**71. (e)**

64 54 69 49 74 44 79

–10 +15 –20 +25 –30 +35

**72. (b)**

514

4000 2008 1012 ? 265 140.5 78.25

÷ 2) + 8 ÷ 2) + 8 ÷ 2) + 8 ÷ 2) + 8 ÷ 2) + 8 ÷ 2) + 8

**73. (c)**

525

5 5 15 75 ? 4725 51975

×1 ×3 ×5 ×7 ×9 ×11

**74. (a)**

195

52 26 26 39 78 ? 585

×0.5 ×1 ×1.5 ×2 ×2.5 ×3

**75. (b)**

410

7 20 46 98 202 ?

+13 +26 +52 +104 +208

×2 ×2 ×2 ×2

**76. (b)**

77

210 209 213 186 202 ?

–1 +4 –27 +16 –125

$(-1)^3$ $(2)^2$ $(-3)^3$ $(4)^2$ $(-5)^3$

**77. (e)**

302

27 38 71 126 203 ?

+(11 × 1) +(11 × 3) +(11 × 5) +(11 × 7) +(11 × 9)

**78. (c)**

120

435 354 282 219 165 ?

–81 –72 –63 –54 –45

+9 +9 +9 +9

**79. (c)**

734

4 200 369 513 634 ?

+196 +169 +144 +121 +100

$(14)^2$ $(13)^2$ $(12)^2$ $(11)^2$ $(10)^2$

**80. (c)**

20

8 11 17 47 128 371 1100

$+3^1$ $+3^2$ $+3^3$ $+3^4$ $+3^5$ $+3^6$

Right number = $11 + 3^2$

= 11 + 9 = 20

Wrong number is 17.

**81. (c)**

29

1 5 13 31 61 125 253

$+2^2$ $+2^3$ $+2^4$ $+2^5$ $+2^6$ $+2^7$

Wrong number is 31.

Right number = $13 + 2^4 = 13 + 16 = 29$.

**82. (d)**

325 314 288 247 191 120

–11 –26 –41 –56 –71

26 – 11 = 15 41 – 26 = 15 56 – 41 = 15 71 – 56 = 15

**83. (b)**

45 46 70 141 353.5 1061.5

×1 + 1 ×1.5 + 1 ×2 + 1 ×2.5 + 1 ×3 + 1

**84. (c)**

620 632 608 644 596 656

+12 –24 +36 –48 +60

**85. (c)**

105

15 25 40 65 ? 170

15 + 25 25 + 40 40 + 65 65 + 105

**86. (e)**

138

3 52 88 113 129 ?

$+7^2$ $+6^2$ $+5^2$ $+4^2$ $+3^2$

So, 138 is the answer.

**87. (c)**

27

2 3 8 ? 112 565

× 1 + 1 × 2 + 2 × 3 + 3 × 4 + 4 × 5 + 5

So, the answer is 27.

**88. (a)**

84.5

6 4 8 23 ? 385.25

× 0.5 + 1 × 1.5 + 2 × 2.5 + 3 × 3.5 + 4 × 4.5 + 5

So, the answer is 84.5.

**89. (d)**

1000

8 64 216 512 ? 1728

$(2)^3$ $(4)^3$ $(6)^3$ $(8)^3$ $(10)^3$ $(12)^3$

So, the answer is 1000.

**90. (b)**

2230

5 11 32 108 444 ?

× 1 + 1 × 6 × 2 + 2 × 5 × 3 + 3 × 4 × 4 + 4 × 3 × 5 + 5 × 2

So, the answer is 2230.

**91. (b)**

9 11 15 23 39 71

$+(2)^1$ $+(2)^2$ $+(2)^3$ $+(2)^4$ $+(2)^5$

So, 23 will come at the place of question mark (?).

**92.** **(e)**

$$7 \xrightarrow{+(1)^2} 8 \xrightarrow{+(2)^2} 12 \xrightarrow{+(3)^2} 21 \xrightarrow{+(4)^2} \boxed{37} \xrightarrow{+(5)^2} 62$$

So, 37 will come at the place of question mark (?).

**93.** **(d)**

$$5 \xrightarrow{\times 1+1^2} 6 \xrightarrow{\times 2+2^2} 16 \xrightarrow{\times 3+3^2} 57 \xrightarrow{\times 4+4^2} 244 \xrightarrow{\times 5+5^2} \boxed{1245}$$

So, 1245 will come at the place of question mark (?).

**94.** **(c)**

$$3 \xrightarrow{\times 6+1} 19 \xrightarrow{\times 5+2} 97 \xrightarrow{\times 4+3} 391 \xrightarrow{\times 3+4} \boxed{1177} \xrightarrow{\times 2+5} 2359$$

So, 1177 will come at the place of question mark (?).

**95.** **(a)**

$$848 \xrightarrow{\times\frac{1}{2}-2} 422 \xrightarrow{\times\frac{1}{2}-3} 208 \xrightarrow{\times\frac{1}{2}-4} 100 \xrightarrow{\times\frac{1}{2}-5} 45 \xrightarrow{\times\frac{1}{2}-6} \boxed{16.5}$$

So, 16.5 will come at the place of question mark (?).

**96.** **(e)**

37.5

$$7.5 \xrightarrow{+30} 47.5 \xrightarrow{+50} 87.5 \xrightarrow{+70} 157.5 \xrightarrow{+90} 247.5 \xrightarrow{+110} 357.3 \xrightarrow{+130} 487.5$$

Right number = 7.5 + 30 = 37.5

So, wrong number = 47.5.

**97.** **(c)**

1836

$$1500 \xrightarrow{+81} 1581 \xrightarrow{+83} 1664 \xrightarrow{+85} 1749 \xrightarrow{+87} 1833 \xrightarrow{+89} 1925 \xrightarrow{+91} 2016$$

Right number = 1836

So, wrong number = 1833.

**98.** **(a)**

4913

| 1331 | 2197 | 3375 | 4914 | 6859 | 9261 | 12167 |
|---|---|---|---|---|---|---|
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| $(11)^3$ | $(13)^3$ | $(15)^3$ | $(17)^3$ | $(19)^3$ | $(21)^3$ | $(23)^3$ |

Right number = $(17)^3$ = 4913

So, wrong number = 4914.

**99.** **(c)**

28

$$13 \xrightarrow{\times 3} 16 \xrightarrow{\times 5} 21 \xrightarrow{\times 7} 27 \xrightarrow{\times 11} 39 \xrightarrow{\times 13} 52 \xrightarrow{\times 17} 69$$

Right number = 21 + 7 = 28

So, wrong number = 27.

**100.** **(b)**

231

$$66 \xrightarrow{\times 25} 91 \xrightarrow{\times 29} 120 \xrightarrow{\times 33} 153 \xrightarrow{\times 37} 190 \xrightarrow{\times 41} 233 \xrightarrow{\times 45} 276$$

Right number = 190 + 41 = 231

So, wrong number = 233.

**101.** **(e)**

80

$$2 \xrightarrow{\times 3+2} 8 \xrightarrow{\times 3+2} 26 \xrightarrow{\times 3+2} ? \xrightarrow{\times 3+2} 272$$

So, 80 will come at the place of question mark.

**102.** **(a)**

45

$$3 \xrightarrow{\times 1+1^2} 4 \xrightarrow{\times 2+2^2} 12 \xrightarrow{\times 3+3^2} ? \xrightarrow{\times 4+4^2} 196$$

Hence, the answer is 45.

**103.** **(d)**

33

$$9 \xrightarrow{\times 2-1} 17 \xrightarrow{\times 2-1} ? \xrightarrow{\times 2-1} 65 \xrightarrow{\times 2-1} 129$$

Hence, the answer is 33.

**104.** **(b)**

25

$$7 \xrightarrow{\times 2-1} 13 \xrightarrow{\times 2-1} ? \xrightarrow{\times 2-1} 49 \xrightarrow{\times 2-1} 97$$

Hence, the answer is 25.

**105.** **(c)**

17.5

$$5 \xrightarrow{\times 0.5+0.5} 3 \xrightarrow{\times 1.5+1.5} 6 \xrightarrow{\times 2.5+2.5} ? \xrightarrow{\times 3.5+3.5} 64.75$$

Hence, the answer is 17.5.

**106.** **(a)**

$$12 \xrightarrow{\times 1} 12 \xrightarrow{\times 1.5} 18 \xrightarrow{\times 2.5} 45 \xrightarrow{\times 4} 180 \xrightarrow{\times 6.5} 1170 \xrightarrow{\times 10.5} \boxed{12285}$$

So, 12285 will come at the place of question mark.

**107.** **(c)**

$$444 \xrightarrow{+23} 467 \xrightarrow{+46} 513 \xrightarrow{+69} 582 \xrightarrow{+92} 674 \xrightarrow{+115} 789 \xrightarrow{+138} \boxed{927}$$

So, 927 will come at the place of question mark.

**108.** **(b)**

| 1 | 16 | 81 | 256 | 625 | 1296 | 2401 |
|---|---|---|---|---|---|---|
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | |
| $(1)^1$ | $(2)^4$ | $(3)^4$ | $(4)^4$ | $(5)^4$ | $(6)^4$ | |

So, 2401 will come at the place of question mark.

**109.** **(e)**

$$23 \xrightarrow{\times 1+2} 25 \xrightarrow{\times 2+3} 53 \xrightarrow{\times 3+4} 163 \xrightarrow{\times 4+5} 657 \xrightarrow{\times 5+6} 3291 \xrightarrow{\times 6+7} \boxed{19753}$$

So, 19753 will come at the place of question mark.

**110.** **(d)**

$$13 \xrightarrow{\times 1} 13 \xrightarrow{\times 5} 65 \xrightarrow{\times 9} 585 \xrightarrow{\times 13} 7605 \xrightarrow{\times 17} 129285 \xrightarrow{\times 21} \boxed{2714985}$$

So, 2714985 will come at the place of question mark.

**111. (a)**

649.6875 1299.375 866.25 346.5 99 22 4

$\times\frac{2}{1}$ $\times\frac{2}{3}$ $\times\frac{2}{5}$ $\times\frac{2}{7}$ $\times\frac{2}{9}$ $\times\frac{2}{11}$

So, 4 will come at the place of question mark.

**112. (d)**

30 16 10 8 8 9 10.5

$\times\frac{1}{2}+1$ $\times\frac{1}{2}+2$ $\times\frac{1}{2}+3$ $\times\frac{1}{2}+4$ $\times\frac{1}{2}+5$ $\times\frac{1}{2}+6$

So, 10.5 will come at the place of question mark.

**113. (b)**

10 18 63 253 1137 5901 35749

$\times1+2^3$ $\times2+2^3$ $\times3+4^3$ $\times4+5^3$ $\times5+6^3$ $\times6+7^3$

So, 35749 will come at the place of question mark.

**114. (e)**

11 26 58 124 258 528 1070

$\times2+4$ $\times2+6$ $\times2+8$ $\times2+10$ $\times2+12$ $\times2+14$

So, 1070 will come at the place of question mark.

**115. (c)**

738 765 819 900 1008 1143 1305

+27 +54 +81 +108 +135 +162

So, 1305 will come at the place of question mark.

**116. (e)**

1075

9050 5675 3478 2147 1418 1077 950

$(5)^3$ $(7)^3$ $(9)^3$ $(11)^3$ $(13)^3$ $(15)^3$

$\therefore$ Hence, 1077 is wrong number.

**117. (d)** $7 \times 2 - 2 = 12$

$12 \times 4 - 8 = 40$

$40 \times 6 - 18 = 222$

$222 \times 8 - 32 = 1742 \rightarrow 1744$

$1744 \times 10 - 50 = 17390$

$17390 \times 12 - 72 = 208608$

Hence, 1742 is wrong number.

Here, $2 = 2 \times \frac{2}{2}$; $8 = 4 \times \frac{4}{2}$; $18 = 6 \times \frac{6}{2}$

$32 = 8 \times \frac{8}{2}$; $50 = 10 \times \frac{10}{2}$; $72 = 12 \times \frac{12}{2}$

**118. (c)**

582

6 91 584 2935 11756 35277 70558

$(6+7)\times7$ $(91+6)\times6$ $(582+5)\times5$ $(2935+4)\times4$ $(11756+3)\times3$ $(35277+2)\times2$

Hence, 584 is the wrong number.

**119. (d)**

27

1 4 25 256 3125 46656 823543

$(1)^1$ $(2)^2$ $(3)^3$ $(4)^4$ $(5)^5$ $(6)^6$ $(7)^7$

Hence, 25 is the wrong number.

**120. (b)**

1053

8424 4212 2106 1051 526.5 263.25 131.625

÷ 2 ÷ 2 ÷ 2 ÷ 2 ÷ 2 ÷ 2

Hence, 1051 is the wrong number.

**121. (c)**

39

4 5 12 38 160 805 4836

$\times1+1$ $\times2+2$ $\times3+3$ $\times4+4$ $\times5+5$ $\times6+6$

Hence, the wrong number is 38.

Right number $= 12 \times 3 + 3 = 36 + 3 = 39$

**122. (a)**

57

3 7 16 32 56 93 142

$+(2)^2$ $+(3)^2$ $+(4)^2$ $+(5)^2$ $+(6)^2$ $+(7)^2$

Hence, the wrong number is 56.

Right number $= 32 + (5)^2$

$= 32 + 25$

$= 57.$

**123. (e)**

78

11 18 29 42 59 80 101

+7 +11 +13 +17 +19 +23

Hence, the wrong number is 80.

Right number $= 59 + 19 = 78.$

**124. (d)**

30

2 9 32 105 436 2195 13182

$\times1+(1\times7)$ $\times2+(2\times6)$ $\times3+(3\times5)$ $\times4+(4\times4)$ $\times5+(5\times3)$ $\times6+(6\times2)$

So, the wrong number is 32.

Right number $= 9 \times 2 + 2 \times 6$

$= 18 + 12$

$= 30.$

**125. (b)**

51975

5 55 495 3465 17325 34650 51975

$\times11$ $\times9$ $\times7$ $\times5$ $\times3$ $\times1$

So, the wrong number is 34650.

Right number $= 17325 \times 3$

$= 51975.$

**126. (c)**

17 52 158 477 1435 4310

$\times3+1$ $\times3+2$ $\times3+3$ $\times3+4$ $\times3+5$

? = 1435

**127. (d)**

3 22 134 673 2696 8093

$\times7+1$ $\times6+2$ $\times5+3$ $\times4+4$ $\times3+5$

? = 134

**128. (a)**

6 13 38 129 532 2675

× 1 + 7, × 2 + 12, × 3 + 15, × 4 + 16, × 5 + 15

+5, +3, +1, –1

–2, –2, –2

? = 70

**129. (e)**

286 142 70 34 16 7

2 – 1, 2 – 1, 2 – 1, 2 – 1, 2 – 1

? = 129

**130. (c)**

17 9 10 16.5 35 90

$\times\frac{1}{2}+0.5$, $\times 1+1$, $\times 1\frac{1}{2}+1.5$, $\times 2+2$, $\times 2\frac{1}{2}+2.5$

? = 10

**131. (e)**

0 5 18 43 84 145 230

+5, +13, +25, +41, +61, +85

+8, +12, +16, +20, +24

+4, +4, +4, +4

**132. (d)**

10 17 48 165 688 3475 20892

× 1 + 7, × 2 + 14, × 3 + 21, × 4 + 28, × 5 + 35, × 6 + 42

**133. (c)**

1 3 24 360 8640 302400 14515200

×3, ×8, ×15, ×24, ×35, ×48

+5, +7, +9, +11, +13

+2, +2, +2, +2

**134. (b)**

12 14 32 102 416 2090 12552

× 1 + 2, × 2 + 4, × 3 + 6, × 4 + 8, × 5 + 10, × 6 + 12

**135. (a)**

10 15 15 12.5 9.375 6.5625 4.375

$\times\frac{3}{2}$, $\times\frac{4}{4}$, $\times\frac{5}{6}$, $\times\frac{6}{8}$, $\times\frac{7}{10}$, $\times\frac{8}{12}$

**136. (e)**

15 25 40 130 510 2560

× 1 + 10, × 2 – 10, × 3 + 10, × 4 – 10, ×5 + 10

**137. (a)**

186 94 48 25 13.5 7.75

$\times\frac{1}{2}+1$, $\times\frac{1}{2}+1$, $\times\frac{1}{2}+1$, $\times\frac{1}{2}+1$, $\times\frac{1}{2}+1$

**138. (b)**

124 112 176 420 1488 7140

$\times 1-(1)^2 \times 12$, $\times 2-(2)^2 \times 12$, $\times 3-(3)^2 \times 12$, $\times 4-(4)^2 \times 12$, $\times 5-(5)^2 \times 12$

**139. (e)**

384 381 372 345 264 21

–3, –9, –27, –81, –243

**140. (d)**

282 286 302 338 402 502

$+(2)^2$, $+(4)^2$, $+(6)^2$, $+(8)^2$, $+(10)^2$

**141. (b)**

2187 729 243 81 27 9 3

$\times\frac{1}{3}$, $\times\frac{1}{3}$, $\times\frac{1}{3}$, $\times\frac{1}{3}$, $\times\frac{1}{3}$, $\times\frac{1}{3}$

So, 3 will come at the place of question mark.

**142. (a)**

522 1235 2661 4800 7652 11217 15495

+(1 × 713), +(2 × 713), +(3 × 713), +(4 × 713), +(5 × 713), +(6 × 713)

So, 15495 will come at the place of question mark.

**143. (c)**

51975 9450 2100 600 240 160 320

$\times\frac{2}{11}$, $\times\frac{2}{9}$, $\times\frac{2}{7}$, $\times\frac{2}{5}$, $\times\frac{2}{3}$, $\times\frac{2}{1}$

So, 320 will come at the place of question mark.

**144. (e)** 4 → 2 × 2

18 → 3 × 6

48 → 4 × 12

100 → 5 × 20

180 → 6 × 30

294 → 7 × 42

448 → 8 × 56

So, 448 will come at the place of question mark.

**145. (d)**

6 26 134 666 3334 16666 83334

×5 – 4, ×5 + 4, ×5 – 4, ×5 + 4, ×5 – 4, ×5 + 4

So, 83334 will come at the place of question mark.

**146. (c)**

30 65 100 165 265 430

30 + 35, 35 + 65, 65 + 100, 100 + 165, 165 + 265

**147. (b)**

3 5 7 10 13 17

+2, +2, +3, +3, +4

So, 10 will come at the place of question mark.

**148. (e)**

+1    +1

16   17   15   18   14   **19**

−1    −1

So 19 will come at the place of question mark.

**149. (a)**

3125   256   27   4   1

$\downarrow$   $\downarrow$   $\downarrow$   $\downarrow$   $\downarrow$

$(5)^5$   $(4)^4$   $(3)^3$   $(2)^2$   $(1)^1$

So, 27 will come at the place of question mark.

**150. (b)**

2   3   6   18   108   **1944**

2 × 3   3 × 6   6 × 18   18 × 108

So, 1944 will come at the place of question mark.

**151. (b)**

**195**

9   15   27   51   99   ?

×2)–3   ×2)–3   ×2)–3   ×2)–3   ×2)–3

**152. (d)** The pattern of series is

13   21   36   58   87   **123**

+8   +15   +22   +29   +36

+7   +7   +7   +7

**153. (d)** The pattern of series is

$7 + (1)^2 + 1 = 9$

$+2 \downarrow$

$9 + (3)^2 + 1 = 19$

$+2 \downarrow$

$19 + (5)^2 + 1 = 45$

$+2 \downarrow$

$45 + (7)^2 + 1 = 95$

$+2 \downarrow$

$95 + (9)^2 + 1 = 177$

**154. (a)**

**121**

14   15   23   32   96   ?

$+(1)^2$   $+(2)^2$   $+(3)^2$   $+(4)^2$   $+(5)^2$

**155. (c)**

**120**

20   24   36   56   84   ?

+4   +12   +20   +28   +36

**156. (e)**

**644**

117   389   525   593   627   ?

+272   +136   +68   +34   +17

**157. (d)**

**187**

7   11   23   51   103   ?

+(4 × 1)   +(4 × 3)   +(4 × 7)   +(4 × 13)   +(4 × 2)

+2   +4   +6   +8

**158. (d)**

**193**

18   27   49   84   132   ?

+9   +22   +35   +48   +6

+13   +13   +13   +13

**159. (b)**

**203**

33   43   65   99   145   ?

+10   +22   +34   +46   +58

+12   +12   +12   +12

**160. (e)**

**215**

655   439   314   250   223   ?

−216   −125   −64   −27   −8

$\downarrow$   $\downarrow$   $\downarrow$   $\downarrow$   $\downarrow$

$(-6)^3$   $(-5)^3$   $(-4)^3$   $(-3)^3$   $(-2)^3$

**161. (e)**

**102**

15   21   39   77   143   ?

+6   +18   +38   +66   +102

+12   +20   +28   +36

+8   +8   +8

**162. (a)**

**183**

33   39   57   87   129   ?

+6   +18   +30   +42   +54

6 × 3   6 × 5   6 × 7   6 × 9

**163. (a)**

**731**

15   19   83   119   631   ?

+4   +64   +36   +512   +100

$\downarrow$   $\downarrow$   $\downarrow$   $\downarrow$   $\downarrow$

$(2)^2$   $(4)^3$   $(6)^2$   $(8)^3$   $(10)^2$

**164. (c)**

**236**

19   26   40   68   124   ?

+7   +14   +28   +56   +112

7 × 2   14 × 2   28 × 2   56 × 2

**165. (e)**

+15 +15 99

43 69 58 84 73 ?

+15 +15

**166. (e)** The sequence of the series is

2.5 4 6.5 10 14.5 20 26.5

+1.5 +2.5 +3.5 +4.5 +5.5 +6.5

+1 +1 +1 +1 +1

**167. (a)** The sequence of the series is

4 5 12 39 160 805 4836

×1 + 1 ×2 + 2 ×3 + 3 ×4 + 4 × 5 + 5 ×6 + 6

**168. (c)** The sequence of the series is

8 108 189 253 302 338 363

$+10^2$ $+9^2$ $+8^2$ $+7^2$ $+6^2$ $+5^2$

**169. (d)** The sequence of the series is

248 217 188 165 146 129 116

–31 –29 –23 –19 –17 –13

In the above series numbers are decreasing by prime numbers.

**170. (a)** The sequence of the series is

3 15 39 75 123 183 255

+12 +24 +36 +48 +60 +72

**171. (d)** The sequence of the series is

1 7 49 343 2401

×7 ×7 ×7 ×7

**172. (d)** The sequence of the series is

13 20 39 78 145 248

+7 +19 +39 +67 +103

+12 +20 +28 +36

+8 +8

**173. (a)** The sequence of the series is

12 35 81 173 357 725

+23 +46 +92 +184 +368

×2 ×2 ×2 ×2

**174. (e)** 3 + 97 = 100

+ 100 ↓

100 + 197 = 297

+ 100 ↓

297 + 297 = 594

+ 100 ↓

594 + 397 = 991

+ 100 ↓

991 + 497 = 1488

**175. (c)**

112 119 140 175 224 287

+7 +21 +35 +149 +363

**176. (a)**

4690

4 10 40 190 940 ? 23440

+6 +30 +150 +750 +3750 +18750

×5 ×5 ×5 ×5 ×5

**177. (b)** 4000 2008 1012 ? 265 140.5 78.25

4000 – 2008 = 1992 ÷ 2 = 996

2008 – 1012 = 996 ÷ 2 = 498

1012 – 514 = 498 ÷ 2 = 249

514 – 265 = 249 ÷ 2 = 124.5

265 – 140.5 = 124.5 ÷ 2 = 62.25

**178. (d)**

20

7 4 5 9 ? 52.5 160.5

×.5+.5 ×1+1 ×1.5+1.5 ×2+2 ×2.5+2.5 ×3+3

**179. (e)**

144

5 54 90 115 131 140 ?

+49 +36 +25 +16 +9 +4

$(7)^2$ $(6)^2$ $(5)^2$ $(4)^2$ $(3)^2$ $(2)^2$

**180. (c)**

252

6 42 ? 1260 5040 15120 30240

×7 ×6 ×5 ×4 ×3 ×2

**181. (b)**

78

13 16 22 33 50 (?)

+3 +6 +11 +18 +27

+3 +5 +7 +9

**182. (c)**

234

39 52 78 117 159 (?)

13×3 13×4 13×6 13×9 13×13 13×18

**183. (a)**

222

656 432 320 264 236 (?)

–224 –112 –56 –28 –14

÷2 ÷2 ÷2 ÷2

**184. (b)**

1437

62 87 187 412 812 (?)

–25 –100 –225 –400 –625

75 125 175 225

+50 +50 +50

**185.** **(a)**

986

7 8 24 105 361 (?)

+1 +16 +81 +256 +625

$(1)^2$ $(4)^2$ $(9)^2$ $(16)^2$ $(25)^2$

4–1=9 9–4=5 15–9=7 25–16=9

**186.** **(d)**

371

9 62 ? 1854 7415 22244

×7–1 ×6–1 ×5–1 ×4–1 ×3–1

Hence, the answer will be 371.

**187.** **(e)**

124

4 8 24 60 ? 224

$+2^2$ $+4^2$ $+6^2$ $+8^2$ $+10^2$

Hence, the answer will be 124.

**188.** **(a)**

2.56

8000 1600 320 64 12.8 ?

÷5 ÷5 ÷5 ÷5 ÷5

Hence, the answer will be 2.56.

**189.** **(b)**

99

6 9 15 27 51 ?

+3×1 +3×2 +3×4 +3×8 +3×16

Hence, the answer will be 99.

**190.** **(c)**

57

7 8 18 ? 232 1165

×1+1 ×2+2 ×3+3 ×4+4 ×5+5

Hence, the answer will be 57.

**191.** **(b)**

170

9 19 40 83 ? 345 696

×2+1 ×2+2 ×2+3 ×2+4 ×2+5 ×2+6

**192.** **(a)** The pattern is:

$1^3 - 1 = 1 - 1 = 0$

$2^3 - 1 = 8 - 1 = 7$

$3^3 - 1 = 27 - 1 = 26$

$4^3 - 1 = 64 - 1 = 63$

$5^3 - 1 = 125 - 1 = 124$

$6^3 - 1 = 216 - 1 = 215 \neq 217$

**193**. (d) The pattern is as given below:

$3 \times 6 = 18$

$18 - 6 = 12$

$12 \times 6 = 72$

$72 - 6 = 66$

$66 \times 6 = 396$

$396 - 6 = 390$

**194.** **(d)** Since, the given numbers are prime numbers, 2, 3, 5, 7, 11, $\boxed{13}$ , 17, 19, ...

∴ Missing number = 13

**195.** **(b)**

46

8 13 21 32 $\boxed{47}$ 63 83

+5 +8 +11 +14 +17 +20

+3 +3 +3 +3 +3

∴ Wrong number = 47

∴ Correct number = 46

**196.** **(a)** The series is + $2^2$, + $4^2$, + $6^2$, + $8^2$, + $10^2$,... Hence, there should be 161 in place of 181.

**197.** **(e)** The series is + 14, + 28, + 56, + 112, + 224, + 448,... Hence, there should be 450 in place of 496.

**198.** **(e)** The series is × 1 + 5.5, × 2 + 5.5, × 3 + 5.5, × 4 + 5.5, × 5+ 5.5, × 6 + 5.5, × 7 + 5.5.

i.e., 15 × 1 + 5.5 = 20.5, 20.5 × 2 + 5.5 = 46.5, 46.5 × 3+5.5= 145, 145 × 4 + 5.5 = 585.5,

585.5 × 5 + 5.5 = 2933, 2933× 6 + 5.5 = 17603.5,

Hence, there should be 20.5 in place of 21.5.

**199.** **(d)** The series is × $1+1^2$, × 2 + $2^2$, × 3 + $3^2$, × 4 + $4^2$, × 5 + $5^2$, ×6 + $6^2$,...

i.e., $5\times1+ 1^2= 6$, $6 \times 2 + 2^2= 16$, $16 \times 3 + 3^2= 57$, $57 \times 4 +4^2= 244$, $244 \times 5 + 5^2= 1245$,

$1245 \times 6 + 6^2= 7506$,

Hence, there should be 244 in place of 246.

**200.** **(b)** The series is + 11, + 33, + 99, + 297, + 891, + 2673,…

i.e., 2 + 11 = 13, 13+33 = 46, 46+99 = 145, 145+297 = 442,442 + 891 = 1333,

1333 + 2673= 4006,

Hence, there should be 442 in place of 452.

**201.** **(a)** The number should be 5555 in place of 5531.

$-7^2, -9^2, -11^2, -13^2, -15^2, -17^2, \ldots$

**202.** **(b)** The number should be 21 in place of 26.

+1, +2, +4, +8, +16, +32

**203.** **(d)** The number should be 770 in place of 760.

×1 + 2, ×2 + 4, ×3 + 6, ×4 + 8, ×5 + 10, ×6 + 12, …

**204.** **(d)** The series is $0^2 + 4$, $1^2 + 2$, $3^2 + 0$, $6^2 - 2$, $10^2 - 4$, $15^2 - 6$, $21^2 - 8$, …

Hence, 435 should be replaced with 433.

**205.** **(a)** The number should be 2 in place of 1.

÷3.5, ÷3, ÷2.5, ÷2, ÷1.5, ÷1, …

**206.** **(d)** The pattern of number series is as follows:

$7 \times 2 - 2 = 12$

$12 \times 4 - (2 + 6) = 48 - 8 = 40$

$40 \times 6 - (8 + 10) = 240 - 18 = 222$

$222 \times 8 - (18 + 14) = 1776 - 32 = 1744 \neq 1742$

$1744 \times 10 - (32 + 18) = 17440 - 50 = 17390$

**207.** **(c)** The pattern of number series is as follow:

$6 \times 7 + 7^2 = 42 + 49 = 91$

$91 \times 6 + 6^2 = 546 + 36 = 582 \neq 584$

$582 \times 5 + 5^2 = 2910 + 25 = 2935$

$2935 \times 4 + 4^2 = 11740 + 16 = 11756$

$11756 \times 3 + 3^2 = 35268 + 9 = 35277$

**208.** **(e)** The pattern of number series is as follows:

$9050 - 15^3 = 9050 - 3375 = 5675$

$5675 - 13^3 = 5675 - 2197 = 3478$

$3478 - 11^3 = 3478 - 1331 = 2147$

$2147 - 9^3 = 2147 - 729 = 1418$

$1418 - 7^3 = 1418 - 343 = 1075 \neq 1077$

**209.** **(d)** The pattern of number series is as follows:

$1^1 = 1;\ 2^2 = 4;\ 3^3 = 27 \neq 25;\ 4^4 = 256;\ 5^5 = 3125;$

$6^6 = 46656;\ 7^7 = 823543$

**210.** **(b)** The pattern of number series is as follows:

$8424 \div 2 = 4212$

$4212 \div 2 = 2106$

$2106 \div 2 = 1053 \neq 1051$

$1053 \div 2 = 526.5$

$526.5 \div 2 = 263.25$

$263.25 \div 2 = 131.625$

**211.** **(d)**

3601 3602 1803 604 155 36 12

+1 + 1, +2 + 2, +3 + 3, +4 + 4, +5 + 5, +6 + 6

154 is written in place of 155.

**212.** **(b)**

4 12 45 196 1005 6066 42511

$\times 2 + (2)^2$, $\times 3 + (3)^2$, $\times 4 + (4)^2$, $\times 5 + (5)^2$, $\times 6 + (6)^2$, $\times 7 + (7)^2$

42 is written in place of 45.

**213.** **(a)**

2 6 12 20 30 42 56

+4, +6, +8, −10, +12, −14

8 is written in place of 6.

**214.** **(e)**

32 16 24 60 210 945 5197.5

×0.5, ×1.5, ×2.5, ×3.5, ×4.5, ×5.5

65 is written in place of 60.

**215.** **(d)**

7 13 25 49 97 193 385

+6, +12, +24, +48, −96, +192

194 is written in place of 193.

**216.** **(b)** The pattern of the number series is as given below:

$8 + 2 = 10$

$10 + 8 = (2 \times 3 + 2) = 18$

$18 + 26 = (3 \times 8 + 2) = 44$

$44 + 80 = (3 \times 26 + 2) = 124$

$124 + 242 = (3 \times 80 + 2) = 366$

**217.** **(d)** The pattern of the number series is as given below:

$13 + 1 \times 12 = 13 + 12 = 25$

$25 + 3 \times 12 = 25 + 36 = 61$

$61 + 5 \times 12 = 61 + 60 = 121$

$121 + 7 \times 12 = 121 + 84 = 205$

$205 + 9 \times 12 = 205 + 108 = 313$

**218.** **(a)** The pattern of the number series is as given below:

$$\frac{656}{2} + 24 = 328 + 24 = 352$$

$$\frac{352}{2} + 24 = 176 + 24 = 200$$

$$\frac{200}{2} + 24 = 100 + 24 = 124$$

$$\frac{124}{2} + 24 = 62 + 24 = 86$$

$$\frac{86}{2} + 24 = 43 + 24 = 67$$

**219.** **(c)** The pattern of the number series is as given below:

$454 + 18 = 472$

$472 - 27 = 445$

$445 + 18 = 463$

$463 - 27 = 436$

$436 + 18 = 454$

**220.** **(b)** The pattern of the number series is as given below:

$12 \times 4 - 30 = 48 - 30 = 18$

$18 \times 4 - 36 = 72 - 36 = 36$

$36 \times 4 - 42 = 144 - 42 = 102$

$102 \times 4 - 48 = 408 - 48 = 360$

$360 \times 4 - 54 = 1440 - 54 = 1386$

**221.** **(c)**

32 49 83 151 287 559 1103

+17, +34, +68, +136, +272, +544

**222.** **(b)**

462 552 650 756 870 992 1122

+90, +98, +106, +114, +122, +130

**223.** **(d)**

15 18 16 19 17 20 18

**224.** **(a)**

1050 420 168 67.2 26.88 10.752 4.3008

÷2.5, ÷2.5, ÷2.5, ÷2.5, ÷2.5, ÷2.5

**225.** **(e)**

$$\begin{array}{ccccccc} 0 & 6 & 24 & 60 & 120 & 210 & 336 \end{array}$$

$$\begin{array}{cccccc} +(6*1) & +(6*3) & +(6*6) & +(6*10) & +(6*15) & +(6*21) \end{array}$$

$$\begin{array}{ccccc} +2 & +3 & +4 & +5 & +6 \end{array}$$

**226.** **(b)** The given series is

$$\times\frac{1}{2}-2,\times\frac{1}{2}-2,\times\frac{1}{2}-2,\times\frac{1}{2}-2,\times\frac{1}{2}-2,\times\frac{1}{2}-2\,.$$

Correct answer is 118 instead of 120.

**227.** **(d)** The given series is

$\times\ 1 + 2, \times\ 2 + 3, \times\ 3 + 4, \times\ 4 + 5, \times\ 5 + 6, \times\ 6 + 7.$

Correct answer is 177 instead of 176.

**228.** **(e)** The given series is

$+(1)^2, +(3)^2, +(5)^2, +(7)^2, +(9)^2, +(11)^2$

Correct answer is 171 instead of 154.

**229.** **(a)** The given series is

$\times\ 1 + (1)^2, \times\ 2 + (2)^2, \times\ 3 + (3)^2, \times\ 4 + (4)^2, \times\ 5 + (5)^2, \times\ 6 + (6)^2$

Correct answer is 6 instead of 7.

**230.** **(c)** The given series is

$$\times\frac{1}{2}+\frac{1}{2}, \times 1+1, \times 1.5+1.5, \times 2+2, \times\ 2.5 + 2.5, \times\ 3 + 3$$

Correct answer is 6.75 instead of 6.5.

**231.** **(d)** The series is $\times 3$.

**232.** **(c)** The series is +12, +15, +18, +21, +24, +27, ...

**233.** **(a)** The series is −200, −100, −50, −25, −12.5, −6.25, ...

**234.** **(a)** The series is −23, −19, −17, −13, −11, −7, ...

(Subtraction of prime numbers. Starting with 23 and following decreasing order)

**235.** **(c)** The series is $\times 1.5, \times 2, \times 1.5, \times 2, \times 1.5, \times 2$, ...

**236.** **(a)** Required ratio

$$=\frac{49\times 125}{100}:83\times\frac{175}{100}=35:83$$

**237.** **(e)** 80% of 125 = 100 and 1% of 125 = 1.25

Students getting less than 81% marks are not eligible to opt science stream in the next year. The number of such students is 3.

**238.** **(b)** Marks obtained

$$=48\times\frac{175}{100}+55\times\frac{120}{100}+94=84+66+94=244$$

**239.** **(d)** The series is $\times\ 7 - 1, \times\ 6 - 1, \times\ 5 - 1, \times\ 4 - 1, \times\ 3 - 1$.

**240.** **(e)** $+ 2^2, + 4^2, + 6^2, + 8^2, + 10^2$.

**241.** **(a)** The series is ÷ 5.

**242.** **(b)** + 3, + 6, + 12, + 24, + 48,…

**243.** **(c)** The series is $\times\ 1 + 1, \times\ 2 + 2, \times\ 3 + 3, \times\ 4 + 4, \times\ 5 + 5$

**244.** **(e)** The series is +7, +11, +13, +17, +19, +23

11 + 7 = 18, 18 + 11 = 29, 29 + 13 = 42,

42 + 17 = 59, 59 + 19 = 78, 78 + 23 = 101

The incorrect number is 80; 59 + 19 = 78

**245.** **(d)** The series is $(+7 \times 1), (+6 \times 2), (+5 \times 3), (+4 \times 4), (+3 \times 5), (+2 \times 6)$.

The incorrect number is 32; $(9 + 6) \times 2 = 15 \times 2 = 30$

**246.** **(b)** The series is $\times 11, \times 7, \times 5, \times 3, \times 1$ and the incorrect number is 34650; $17325 \times 3 = 51975$

**247.** **(a)** The series is $+2^2, +3^2, +4^2, +5^2, 6^2, +7^2$

The incorrect number is 56; $32 + 5^2 = 32 + 25 = 57$

**248.** **(c)** The series is $\times 1 + 1, \times 2 + 2, \times 3 + 3, \times 4 + 4, \times 5 + 5, \times 6 + 6$.

The incorrect number is 38; $12 \times 3 + 3 = 36 + 3 = 39$

**249.** **(e)** The series is $\times 1 + 10, \times 2 - 10, \times 3 + 10, \times 4 - 10, \times 5 + 10$

$130 \times 4 - 10 = 520 - 10 = 510$

**250.** **(a)** The series is ÷ 2 + 1.

$$\frac{25}{2}+1=13.5$$

**251.** **(b)**

**252.** **(e)** The series is −3, −9, −27, −81, −243

264 − 243 = 21

**253.** **(d)** The series is

$+2^2, +4^2, +6^2, +8^2, +10^2, \ldots$

$302 + 6^2 = 302 + 36 = 338$

**254.** **(c)** The series is $\times 3 - 13$

**255.** **(c)** The series is $+2^2,\ +2^3,\ +2^4,\ +2^5,\ +2^6,\ +2^7$

# Clocks and Calendar

# 24

## CLOCKS

The circumference of a dial of a clock (or watch) is divided into 60 equal parts called **minute spaces.** The clock has two hands—the hour hand and the minute hand. The hour hand (or short hand) indicates time in hours and the minute hand (or long hand) indicates time in minutes. In an hour, the hour hand covers 5 minute spaces while the minute hand covers 60 minute spaces. Thus, in one hour or 60 minutes, the minute hand gains 55 minute spaces over the hour hand.

## SOME BASIC FACTS

1. In every hour:
   (a) Both the hands coincide once.
   (b) The hands are straight (point in opposite directions) once. In this position, the hands are 30 minute spaces apart.
   (c) The hands are twice at right angles. In this position, the hands are 15 minute spaces apart.
2. The minute hand moves through 6° in each minute whereas the hour hand moves through $\frac{1}{2}^\circ$ in each minute. Thus, in one minute, the minute hand gains $5\frac{1}{2}^\circ$ than the hour hand.
3. (a) When the hands are coincident, the angle between them is 0°.
   (b) When the hands point in opposite directions, the angle between them is 180°.
   (c) The hands are in the same straight line, when they are coincident or opposite to each other. So, the angle between the two hands is either 0° or 180°.
3. The minute hand moves 12 times as fast as the hour hand.
4. If a clock indicates 6:10, when the correct time is 6, it is said to be 10 minutes **too fast**. And if it indicates 5:50, when the correct time is 6, it is said to be 10 minutes **too slow**.

## SOME USEFUL SHORTCUT METHODS

1. The two hands of the clock will be together between $H$ and $(H + 1)$ O'clock at $\left(\frac{60H}{11}\right)$ minutes past $H$ O'clock.

**Explanation**

At $H$ O'clock the minute hand is $5H$ minute spaces behind the hour hand.

$\because$ The minute hand gains 55 minute spaces in 60 minute,

$\therefore$ The minute hand will gain $5H$ minute spaces in $\frac{60}{55} \times 5H = \frac{60H}{11}$ minutes. Thus, the two hands of clock will be together between $H$ and $(H + 1)$ O'clock at $\left(\frac{60H}{11}\right)$ minutes past $H$ O'clock.

**Illustration 1:** At what time between 5 and 6 O'clock are the hands of a clock together?

**Solution:** Here, $H = 5$.

$\therefore \quad \frac{60H}{11} = \frac{60}{11} \times 5 = \frac{300}{11} = 27\frac{3}{11}$.

$\therefore$ Hands of a clock are together at $22\frac{3}{11}$ minutes past 5 O'clock.

> 2. The two hands of the clock will be at right angles between $H$ and $(H + 1)$ O'clock at $(5H \pm 15)\frac{12}{11}$ minutes past $H$ O'clock.

**Explanation**

At $H$ O'clock, the minute hand will be $5H$ minute spaces behind the hour hand. When the two hands are at right angle, they are 15 minute spaces apart. So there can be two cases:

**Case I** The minute hand is 15 minute spaces behind the hour hand. In this case, the minute hand will have to gain $(5H - 15)$ minute spaces over the hour hand.

**Case II** The minute hand is 15 minute spaces ahead of the hour hand. In this case, the minute hand will have to gain $(5H + 15)$ minute spaces over the hour hand. Combining the two cases, the minute hand will have to gain $(5H \mp 15)$ minute spaces over the hour hand.

Now, 55 minute spaces are gained in 60 minutes.

$\therefore$ $(5H \mp 15)$ minute spaces are gained in

$$\frac{60}{55}(5H \mp 15) = \frac{12}{11}(5H \mp 15) \text{ minutes.}$$

So, they are at right angle at $(5H \mp 15)\frac{12}{11}$ minutes past $H$ O'clock.

**Illustration 2:** At what time between 5 and 6 O'clock will the hands of a clock be at right angle?

**Solution:** Here, $H = 5$

$$\therefore \quad (5H \mp 15)\frac{12}{11} = (5 \times 5 \mp 15)\frac{12}{11} = 10\frac{10}{11} \text{ and } 43\frac{7}{11}$$

$\therefore$ Hands of a clock are at right angle at $10\frac{10}{11}$ minutes past 5 and $43\frac{7}{11}$ minutes past 5.

> 3. The two hands of the clock will be in the same straight line but not together between $H$ and $(H + 1)$ O'clock at,
>
> $(5H - 30)\frac{12}{11}$ minutes past $H$, when $H > 6$
>
> and, $(5H + 30)\frac{12}{11}$ minutes past $H$, when $H < 6$.

**Illustration 3:** Find at what time between 2 and 3 O'clock will the hands of a clock be in the same straight line but not together.

**Solution:** Here, $H = 2 < 6$.

$$\therefore \quad (5H + 30)\frac{12}{11} = (5 \times 2 + 30)\frac{12}{11} = \frac{480}{11}, \text{ i.e., } 43\frac{7}{11}.$$

So, the hands will be in the same straight line but not together at $43\frac{7}{11}$ minutes past 2 O'clock.

> 4. Between $H$ and $(H + 1)$ O'clock, the two hands of a clock are $M$ minutes apart at $(5H \mp M)\frac{12}{11}$ minutes past $H$ O'clock.

**Explanation**

At $H$ O'clock, the two hands are $5H$ minute spaces apart.

**Case I** Minute hand is $M$ minute spaces behind the hour hand. In this case, the minute hand has to gain $(5H - M)$ minute spaces over the hour hand.

**Case II** Minute hand is $M$ minute spaces ahead of the hour hand. In this case, the minute hand has to gain $(5H + M)$ minute spaces over the hour hand.

Combining the two cases, the minute hand has to gain $(5H \pm M)$ minute spaces over the hour hand.

Now, 55 minute spaces are gained in 60 minutes.

$\therefore$ $(5H \pm M)$ minute spaces are gained in

$$\frac{60}{55}(5H \mp M) = \frac{12}{11}(5H \mp M) \text{ minutes.}$$

$\therefore$ The hands will be $M$ minutes apart at,

$$\frac{12}{11}(5H \mp M) \text{ minutes past } H \text{ O'clock.}$$

**Illustration 4:** Find the time between 4 and 5 O'clock when the two hands of a clock are 4 minutes apart.

**Solution:** Here, $H = 4$ and $M = 4$.

$$\therefore \quad \frac{12}{11}(5H \mp M) = \frac{12}{11}(5 \times 4 \mp 4)$$

$$= 26\frac{2}{11} \text{ and } 17\frac{5}{11}.$$

$\therefore$ The hands will be 4 minutes apart at $26\frac{2}{11}$ minutes past 4 and $17\frac{5}{11}$ minutes past 4 O'clock.

5. Angle between the hands of a clock
   (a) When the minute hand is behind the hour hand, the angle between the two hands at $M$ minutes past $H$ O'clock $= 30\left(H - \frac{M}{5}\right) + \frac{M}{2}$ degrees.
   (b) When the minute hand is ahead of the hour hand, the angle between the two hands at $M$ minutes past $H$ O'clock $= 30\left(\frac{M}{5} - H\right) - \frac{M}{2}$ degree.

**Illustration 5:** Find the angle between the two hands of a clock at 15 minutes past 4 O'clock.

**Solution:** Here, $H = 4$ and $M = 15$.

$\therefore$ The required angle

$$= 30\left(H - \frac{M}{5}\right) + \frac{M}{2} \text{ degrees}$$

$$= 30\left(4 - \frac{15}{5}\right) + \frac{15}{2} + \frac{75}{2}$$

$$= \frac{75}{2}, \text{ i.e., } 37.5°.$$

6. The minute hand of a clock overtakes the hour hand at intervals of $M$ minutes of correct time. The clock gains or loses in a day by

$$= \left(\frac{720}{11} - M\right)\left(\frac{60 \times 24}{M}\right) \text{minutes.}$$

**Illustration 6:** The minute hand of a clock overtakes the hour hand at intervals of 65 minutes. How much in day does the clock gain or lose?

**Solution:** Here, $M = 65$

$\therefore$ The clock gains or, loses in a day by

$$= \left(\frac{720}{11} - M\right)\left(\frac{60 \times 24}{M}\right)$$

$$= \left(\frac{720}{11} - 65\right)\left(\frac{60 \times 24}{65}\right)$$

$$= \frac{5}{11} \times \frac{12 \times 24}{13} = \frac{1440}{143}$$

$$= 10\frac{10}{143} \text{ minutes.}$$

Since the sign is +ve, the clock gains by $10\frac{10}{143}$ minutes.

## CALENDAR

In this section we shall mainly deal with finding the day of the week on a particular given date. The process of finding it depends upon the number of odd days, which are quite different from the odd numbers. So, we should be familiar with **odd days.**

### Odd Days

The days more than the complete number of weeks in a given period are called odd days.

### Ordinary Year

An ordinary year has 365 days.

### Leap Year

That year (except century) which is divisible by 4 is called a leap year, whereas century is a leap year by itself when it is divisible by 400.

For example, 1964, 1968, 1972, 1984, and so on, are all leap years whereas 1986, 1990, 1994, 1998, and so on, are not leap years.

Further, the centuries 1200, 1600, 2000 and so on, are all leap years as they are divisible by 400 whereas 900, 1300, 1500 and so on, are not leap years.

## SOME BASIC FACTS

1. An ordinary year has 365 days, i.e., 52 weeks and 1 odd day.
2. A leap year has 366 days, i.e., 52 weeks and 2 odd days.
3. A century has 76 ordinary years and 24 leap years.
   $\therefore$ 100 years = 76 ordinary years + 24 leap years
   = 76 odd days + 24 × 2 odd days
   = 124 odd days = 17 weeks + 5 days
   $\therefore$ 100 years contain 5 odd days.
4. 200 years contain 10 days and therefore 3 odd days.
5. 300 years contain 15 days and therefore 1 odd day.
6. 400 years contain (20 + 1) days and therefore 1 odd day.
7. February in an ordinary year has no odd day, but in a leap year has one odd day.
8. Last day of a century cannot be either Tuesday, Thursday or Saturday.
9. The first day of a century must either be Monday, Tuesday, Thursday or Saturday.

**Explanation**

Number of odd days in first century = 5

∴ Last day of first century is Friday.

Number of odd days in two centuries = 3

∴ Wednesday is the last day.

Number of odd days in three centuries = 1

∴ Monday is the last day.

Number of odd days in four centuries = 0

∴ Last day is Sunday.

Since the order is continually kept in successive cyles, the last day of a century cannot be Tuesday, Thursday or Saturday. So, the last day of a century should be either Sunday, Monday, Wednesday or Friday. Therefore, the first day of a century must be either Monday, Tuesday, Thursday or Saturday.

## SOME USEFUL SHORTCUT METHODS

1. Working rule to find the day of the week on a particular date when reference day is given:

**Step I** Find the net number of odd days for the period between the reference day and the given date (Exclude the reference day but count the given date for counting the number of net odd days).

**Step II** The day of the week on the particular date is equal to the number of net odd days ahead of the reference day (if the reference day was before this date) but behind the reference day (if this date was behind the reference day).

**Illustration 7:** January 11, 1997 was a Sunday. What day of the week was on January 7, 2000?

**Solution:** Total number of days between January 11, 1997 and January 7, 2000

= (365 − 11) in 1997 + (365 days in 1998)
+ (365 days in 1999) + (7 days in 2000)

= (50 weeks + 4 odd days) + (52 weeks + 1 odd day)
+ (52 weeks + 1 odd day) + (7 odd days)

= 13 days = 1 week + 6 odd days.

Hence, January 7. 2000 would be 6 days ahead of Sunday, i.e., it was on Saturday.

2. Working Rule to find the day of the week on a particular date when no reference day is given

**Step I** Count the net number of odd days on the given date.

**Step II** Write:
Sunday for 0 odd day
Monday for 1 odd day
Tuesday for 2 odd days
⋮ ⋮ ⋮
Saturday for 6 odd days.

**Illustration 8:** What day of the week was on June 5, 1999?

**Solution:** June 5, 1999 means 1998 years + first five months up to May of 1999 + 5 days of June.

1600 years have 0 odd day.

300 years have 1 odd day.

98 years have 24 leap years + 74 ordinary years
= (24 × 2) + (74 × 1) days
= 122 days = 17 weeks + 3 odd days

Thus, 1998 years have 4 odd days.

January 1, 1999 to May 31 1999, has
= (3 + 0 + 3 + 2 + 3 + 5) 2 odd days
= 16 days = 2 weeks + odd days

Total number of odd days on June 5, 1999
= (4 + 2) odd days = 6 odd days.

Hence, June 5, 1999 was Saturday.

## EXERCISE-I

**1.** At what time between 3 and 4 O'clock are the hands of a clock together?

(a) $15\frac{7}{11}$ minutes past 4

(b) $16\frac{4}{11}$ minutes past 3

(c) $16\frac{2}{11}$ minutes past 2

(d) None of these

**2.** At what time between 7 and 8 O'clock will the hands of a clock be at right angle?

(a) $19\frac{5}{11}$ minutes past 2

(b) $21\frac{9}{11}$ minutes past 7

(c) 18 minutes past 4

(d) None of these

**3.** Find at what time between 8 and 9 O'clock will the hands of a clock be in the same straight line but not together?

(a) $11\frac{9}{11}$ minutes past 5

(b) $9\frac{7}{11}$ minutes past 5

(c) $10\frac{10}{11}$ minutes past 8

(d) None of these

**4.** At what time between 5 and 6 O'clock are the hands of a clock 3 minutes apart?

(a) 24 minutes past 5 (b) 22 minutes past 3

(c) 26 minutes past 4 (d) None of these

**5.** Find the angle between the two hands of a clock at 30 minutes past 4 O'clock.

(a) 40° (b) 30°

(c) 45° (d) None of these

**6.** How much does a watch gain or lose per day, if its hands coincide in every 64 minutes?

(a) $32\frac{8}{11}$ minutes gain

(b) $34\frac{2}{11}$ minutes gain

(c) $32\frac{8}{11}$ minutes loss

(d) None of these

**7.** How often between 11 O'clock and 12 O'clock are the hands of a clock in integral number of minutes apart?

(a) 55 times (b) 56 times

(c) 58 times (d) 60 times

**8.** Number of times the hands of a clock are in a straight line everyday is:

(a) 44 (b) 24

(c) 42 (d) 22

**9.** My watch gains 5 seconds in 3 minutes was set right at 7 am. In the afternoon of the same day, when the watch indicates quarter past 4 O'clock, the true time is:

(a) $59\frac{7}{12}$ minutes. past 3

(b) $12\frac{3}{11}$ minutes. past 3

(c) 4 pm

(d) $7\frac{5}{12}$ minutes. past 4

**10.** My watch gains 5 minutes. in every hour. How many degrees the second hand moves in every minute?

(a) 375° (b) 380°

(c) 390° (d) 365°

**11.** At what time between 4:30 and 5 will the hands of a clock be in a straight line?

(a) 50 minutes. past 4

(b) 42 minutes. past 4

(c) $54\frac{6}{11}$ minutes. past 4

(d) 46 minutes. past 4

**12.** Two clocks are set right at 10 am. One gains 20 seconds and the other loses 40 seconds in 24 hours. What will be the true time when the first clock indicates 4 pm on the following day?

(a) $3{:}59\frac{2521}{4321}$ pm (b) $3{:}31\frac{1}{471}$ pm

(c) $3{:}59\frac{7}{12}$ pm (d) $3{:}57\frac{2521}{4321}$ pm

**13.** A clock takes 9 seconds to strike 4 times. In order to strike 12 times at the same rate, the time taken is:

(a) 27 seconds (b) 36 seconds

(c) 30 seconds (d) 33 seconds

**14.** How often are the hands of a clock at right angle everyday?
(a) 38 times (b) 44 times
(c) 40 times (d) 48 times

**15.** A clock is set right at 5 am. The clock loses 16 minutes. in 24 hours. What will be the true time when the clock indicates 10 pm. on the 4th day?
(a) 9 am (b) 11 pm
(c) 11 am (d) 9 pm

**16.** My watch was 3 minutes slow at 5 pm on Tuesday and it was 5 minutes fast at 11 pm on Wednesday. When did it give correct time?
(a) Wednesday 4:15 am
(b) Wednesday 7:30 am
(c) Tuesday 3:45 pm
(d) None of these

**17.** How many times do the hands of a clock point towards each other in a day?
(a) 24 (b) 20
(c) 12 (d) 22

**18.** A man who went out between 3 and 4 and returned between 8 and 9, found that the hands of the watch had exactly changed places. He returned at:
(a) 14 minutes. past 8
(b) $21\frac{1}{13}$ minutes. past 8
(c) $19\frac{2}{13}$ minutes. past 8
(d) $18\frac{6}{13}$ minutes. past 8

**19.** A clock gains 10 minutes in every 24 hours. It is set right on Monday at 8 am. What will be the correct time on the following Wednesday, when the watch indicates 6 pm?
(a) 5.36 pm. (b) 5.40 pm.
(c) 4.36 pm. (d) None of these

**20.** If the hands of a clock coincide in every 65 minutes (true time), in 24 hours the clock will gain:
(a) $10\frac{10}{143}$ minutes. (b) $9\frac{12}{143}$ minutes.
(c) $11\frac{12}{143}$ minutes. (d) $12\frac{10}{143}$ minutes.

**21.** The watch which gains uniformly is 2 minutes. slow at noon on Sunday and is 4 minutes. 48 seconds. fast at 2 pm on the following Sunday. The watch was correct at:
(a) 2 pm on Tuesday
(b) 12 noon on Monday
(c) 1:30 pm on Tuesday
(d) 12:45 pm on Monday

**22.** A watch which gains uniformly is 6 minutes slow at 4 pm on a Sunday and $10\frac{2}{3}$ minutes fast on the following Sunday at 8 pm. During this period (Day and Time) when was the watch correct?
(a) 2.36 am (b)1.36 am
(c) 2.36 pm (d)1.36 pm

**23.** If a clock takes 22 seconds to strike 12, how much time will it take to strike 6?
(a) 10 seconds (b) 12 seconds
(c) 14 seconds (d) None of these

**24.** Mahatma Gandhi was born on October 2, 1869. The day of the week was:
(a) Sunday (b) Monday
(c) Saturday (d) Friday

**25.** March 5, 1999 was on Friday. What day of the week was on March 5, 2000?
(a) Monday (b) Sunday
(c) Friday (d) Tuesday

**26.** On what date of August, 1988 did Friday fall?
(a) 5 (b) 4
(c) 14 (d) 17

**27.** India got independence on August 15, 1947. What was the day of the week?
(a) Monday (b) Friday
(c) Thursday (d) Sunday

**28.** January 7, 1992 was Tuesday. Find the day of the week on the same date after 5 years, i.e., on January 7, 1997?
(a) Tuesday (b) Wednesday
(c) Saturday (d) Friday

**29.** Number of times 29th day of the month occurs in 400 consecutive years is:
(a) 4497 (b) 4800
(c) 4400 (d) None of these

**30.** The first Republic Day of India was celebrated on January 26, 1950. What was the day of the week on that date?
(a) Monday (b) Wednesday
(c) Saturday (d) Thursday

**31.** In an ordinary year 'March' begin on the same day of the week:
(a) February; November
(b) January; November
(c) February; October
(d) January; September

**32.** If March 2, 1994 was on Wednesday, January 1994 25, was on:
(a) Wednesday (b) Thursday
(c) Tuesday (d) Monday

**33.** Calendar for 2000 will serve for also:
(a) 2003 (b) 2006
(c) 2007 (d) 2005

## EXERCISE-2
## (BASED ON MEMORY)

**1.** A clock strikes once at 1 O'clock, twice at 2 O'clock, thrice at 3 O'clock and so on. How many times will it strike in 24 hours?

(a) 78 (b) 136
(c) 156 (d) 196

**[(GL) Prel. Examination, 2002]**

**2.** The minute hand of a clock is 7 cm long. The area swept by the minute hand in 15 minutes will be:

(a) 25.6 $cm^2$ (b) 38.5 $cm^2$
(c) 44.0 $cm^2$ (d) 77.0 $cm^2$

**[SI Rec. Examination, 1997]**

**3.** If a clock strikes 6 times in five seconds, the number of strikes in 10 seconds is:

(a) 10 (b) 11
(c) 9 (d) 8

**[Assstant's Grade Examination, 1998]**

**4.** If the day after tomorrow is Sunday, what day was tomorrow's day before yesterday?

(a) Friday (b) Thursday
(c) Monday (d) Tuesday

**[SSC (GL) Examination, 2010]**

**5.** At what time are the hands of clocks together between 6 and 7?

(a) $32\frac{8}{11}$ minutes past 6

(b) $34\frac{8}{11}$ minutes past 6

(c) $30\frac{8}{11}$ minutes past 6

(d) $32\frac{5}{7}$ minutes past 6

**[SSC (GL) Examination, 2011]**

**6.** Suresh was born on October 4, 1999. Shashikanth was born 6 days before Suresh. The Independence day of that year fell on Sunday. Which day was Shashikanth born?

(a) Tuesday (b) Wednesday
(c) Monday (d) Sunday

**[SSC (GL) Examination, 2011]**

**7.** After 9'O clock at what time between 9 pm and 10 pm will the hour and minute hands of a clock point in opposite direction?

(a) 15 minutes past 9 (b)16 minutes past 9

(c) $16\frac{4}{11}$ minutes past 9 (d) $17\frac{1}{11}$% minutes past 9

**[SSC (GL), 2011]**

**8.** If John celebrated his victory day on Tuesday, January 5, 1965, when will he celebrate his next victory day on the same day?

(a) January 5, 1970 (b) January 5, 1971
(c) January 5, 1973 (d) January 5, 1974

**[SSC (GL) Examination, 2011]**

**9.** In the year 1996, the Republic day was celebrated on Friday. On which day was the Independence day celebrated in the year 2000?

(a) Tuesday (b) Monday
(c) Friday (d) Saturday

**[SSC (GL) Examination, 2011]**

**10.** A girl was born on September 6, 1970 which happened to be a Sunday. Her birthday would have fallen again on Sunday in:

(a) 1975 (b) 1977
(c) 1981 (d) 1982

**[UPPCS Examination, 2012]**

**11.** In every 30 minutes the time of a watch increases by 3 minutes. After setting the correct time at 5 am what time will the watch show after 6 hours?

(a) 10:54 am (b) 11:30 am
(c) 11:36 am (d) 11:42 am

**[Corporation Bank PO Examination, 2009]**

**12.** A wall clock gains 2 minutes in 12 hours, while a table clock loses 2 minutes every 36 hours. Both are set right at 12 noon on Tuesday. The correct time when both show the same time next would be:

(a) 12.30 at night, after 130 days
(b) 12 noon, after 135 days
(c) 1.30 at night, after 130 days
(d) 12 midnight, after 135 days

**[SSC Examination, 2012]**

**13.** In every 30 minutes the time of a watch increases by 3 minutes. After setting the correct time at 5 am, what time will the watch show after 6 hours?

(a) 10:54 am (b) 11:30 am
(c) 11:36 am (d) 11:42 am
(e) 11:38 pm

**[Corporation Bank PO Examination, 2009]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (b) | **3.** (c) | **4.** (a) | **5.** (c) | **6.** (a) | **7.** (b) | **8.** (a) | **9.** (c) | **10.** (c) | **11.** (c) | **12.** (a) | **13.** (d) |
| **14.** (b) | **15.** (b) | **16.** (a) | **17.** (d) | **18.** (d) | **19.** (a) | **20.** (a) | **21.** (a) | **22.** (b) | **23.** (a) | **24.** (c) | **25.** (b) | **26.** (a) |
| **27.** (b) | **28.** (a) | **29.** (a) | **30.** (d) | **31.** (a) | **32.** (c) | **33.** (d) | | | | | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (b) | **3.** (b) | **4.** (b) | **5.** (a) | **6.** (a) | **7.** (c) | **8.** (b) | **9.** (a) | **10.** (c) | **11.** (c) | **12.** (b) | **13.** (c) |

# EXPLANATORY ANSWERS

## Exercise-1

**1.** **(c)** Here, $H = 3$.

$\therefore \quad \frac{60H}{11} = \frac{60}{11} \times 3 = \frac{180}{11} = 16\frac{4}{11}$.

So, the hands of a clock will coincide at $16\frac{4}{11}$ minutes past 3.

**2.** **(b)** Here, $H = 7$

$\therefore \quad (5H \pm 15)\frac{12}{11} = (5 \times 7 \pm 15)\frac{12}{11}$

$= 21\frac{9}{11}$ and $54\frac{6}{11}$.

$\therefore$ The hands of a clock are at right angle at $21\frac{9}{11}$ minutes past 7 and, $54\frac{6}{11}$ minutes past 7 O'clock.

**3.** **(c)** Here, $H = 8 > 6$.

$\therefore \quad (5H - 30)\frac{12}{11} = (5 \times 8 - 30)\frac{12}{11} = \frac{120}{11} = 10\frac{10}{11}$.

So, the hands will be in the same straight line but not together at $10\frac{10}{11}$ minutes past 8 O'clock.

**4.** **(a)** Here, $H = 5$ and $M = 3$.

$\therefore \quad \frac{12}{11}(5H \pm M) = \frac{12}{11}(5 \times 5 \pm 3) = 31\frac{5}{11}$ and 24.

$\therefore$ The hands will be 3 minutes apart at $31\frac{5}{11}$ minutes past 5 and 24 minutes past 5 O'clock.

**5.** **(c)** Here, $H = 4$ and $M = 30$.

$\therefore$ The required angle $= 30\left(\frac{M}{5} - H\right) - \frac{M}{2}$ degrees

$= 30\left(\frac{30}{5} - 4\right) - \frac{30}{2}$

$= 60 - 15 = 45°$.

**6.** **(a)** Here, $M = 64$

$\therefore$ The clock gains or loses in a day by

$= \left(\frac{720}{11} - M\right)\left(\frac{60 \times 24}{M}\right)$

$= \left(\frac{720}{11} - 64\right)\left(\frac{60 \times 24}{64}\right)$

$= \left(65\frac{5}{11} - 64\right) \times \left(\frac{60 \times 24}{64}\right)$

$= \frac{16}{11} \times \frac{60 \times 24}{64} = \frac{360}{11} = 32\frac{8}{11}$ minutes.

Since the sign is +ve, the clock gains by $32\frac{8}{11}$ minutes.

**7.** **(b)** At 11 O'clock, the hour hand is 4 spaces apart from the minute hand. Since there are 60 spaces in one hour, so (60 − 4) times, i.e., 56 times the hands of the clock are an integral number of minutes apart.

**8.** **(a)** We know that, any relative position of the hands of a clock is repeated 11 times in every 12 hours.

$\therefore$ In every 12 hours, hands coincide 11 times and are opposite to each other 11 times.

$\therefore$ In every 12 hours, hands are in a straight line 11 + 11 = 22 times.

$\therefore$ In every 24 hours hands are in a straight line 44 times.

**9.** **(c)** From 7 am to 4:15 pm, the time is 9 hours 15 minutes, i.e., 555 minutes.

Now, $\frac{37}{12}$ minutes of this watch = 3 minutes of correct watch.

$\Rightarrow$ 555 minutes of this watch $= \left(\frac{3\times12}{37}\times555\right)$ minutes on a correct watch = 540 minutes or 9 hours of correct watch.

$\therefore$ Correct time after 7 am is 4 pm.

**10.** **(c)** Since minute hand gains 5 minutes in every 60 minutes

$\Rightarrow$ second hand gains 5 seconds in every 60 seconds

$\therefore$ In every 60 seconds true time, it moves 65 seconds or, $65 \times 6° = 390°$.

**11.** **(c)** At 4 O'clock hands are 20 minutes spaces apart. At time between 4:30 and 5 the hands will be in straight line when they point in opposite directions and there is a space of 30 minutes. between them. So, to be in this position minute hand has to gain 30 + 20 = 50 minutes. spaces. Minute hand gains 50 minutes in

$$\frac{60}{55}\times50=54\frac{6}{11} \text{ minutes.}$$

$\therefore$ Required time $= 54\frac{6}{11}$ minutes past 4.

**12.** **(a)** From 10 am to 4 pm on the following day = 30 hours

Now, 24 hours 20 seconds of the first clock

= 24 hours of the current clock.

$\therefore$ 1 hour of the first clock $= \frac{24\times180}{4321}$ hours

$\therefore$ 30 hours of the first clock $= \frac{24\times180\times30}{4321}$ hours

Now, $\frac{24\times180\times30}{4321}$ hours = 29 hours 59 $\frac{2521}{4321}$ minutes.

$\therefore$ When the first clock indicates 4 pm on the following day the true time will be 3 hours 59 $\frac{2521}{4321}$ minutes.

**13.** **(d)** There are 3 intervals when the clock strikes 4

Time taken in 3 intervals = 9 seconds

$\therefore$ Time taken for 1 interval = 3 seconds

In order to strike 12, there are 11 intervals, for which the time taken is $11 \times 3$ seconds = 33 seconds.

**14.** **(b)** In every hour there are two positions in which hands are at right angle. Each of these positions is repeated 11 times in every 12 hours.

$\therefore$ In every 12 hours, hands are at right angles 11 + 11 = 22 times and in a day hands are at right angles 22 + 22 = 44 times.

**15.** **(b)** From 5 am on first day to 10 pm on 4th day is 89 hours. When a clock loses 16 minutes then 23 hours 44 minutes of this clock are the same as 24 hours of correct clock, i.e., $\frac{356}{15}$ hours of this clock = 24 hours of correct clock.

$\therefore$ 89 hours of this clock.

$= \left(\frac{24\times15}{356}\times89\right)$ hours of correct clock

= 90 hours of correct clock

$\therefore$ The correct time is 11 pm.

**16.** **(a)** Time from 5 pm Tuesday to 11 pm Wednesday = 30 hours

Clock gains 8 minutes in 30 hours

$\therefore$ It gains 3 minutes in $\frac{30}{8}\times 3$ hours

= 11 hours 15 minutes.

$\therefore$ Correct time is 11 hours. 15 minutes after 5 pm.

= 4:15 am on Wednesday.

**17.** **(d)** The hands of a clock point towards each other 11 times in every 12 hours. (because between 5 and 7, at 6 O'clock only they point towards each other)

So, in a day the hands point towards each other 22 times.

**19.** **(a)** Total number of hours from Monday at 8 am to the following Wednesday at 6 pm.

$24 \times 2 + 10 = 58$ hours

24 hours 10 minutes of this clock are the same as 24 hours of a correct clock.

$\frac{145}{6}$ hours of the incorrect clock = 24 hours of correct clock.

58 hours of the incorrect clock $= \frac{24\times6}{145}\times58$ hours of correct clock $= 57\frac{3}{5}$ hours of correct clock.

Thus, the correct time on the following Wednesday will be 5:36 pm.

**20.** **(a)** The minutes hand gains 60 minutes in $\frac{60}{55}\times 60$

$$= \frac{720}{11} = 65\frac{5}{11} \text{ minutes.}$$

$\therefore$ The hands of a correct clock coincide in every $65\frac{5}{11}$ minutes. But the hands of the clock in question coincide in every 65 minutes.

The clock in question gains $\frac{5}{11}$ minutes in 65 minutes.

$\therefore$ In 24 hours = $24 \times 60$ minutes the clock gains

$\frac{5}{11}\times\frac{1}{65}\times24\times60 = \frac{1440}{143}$ minutes $= 10\frac{10}{143}$ minutes

**21.** **(a)** From Sunday noon to the following Sunday at 2 pm, total time = 7 days + 2 hours

= $(7 \times 24 + 2)$ hours = 170 hours.

In this period watch gains 2 + 4 minutes 48 seconds

$= 6\frac{48}{60} = 6\frac{4}{5}$ minutes.

$\therefore$ Watch gains $6\frac{4}{5}$ minutes in 170 hours.

$\therefore$ Watch gains 2 minutes in $\frac{170}{34}\times5\times2 = 50$ hours

i.e., 2 days and 2 hours.

∴ Watch will be correct at 2 pm on Tuesday.

**22.** **(b)** Total time in hours from Sunday at 4 pm to the following Sunday at 8 am.

$= 6 \times 24 + 16 = 160$ hours

Thus, the watch gains $6 + 10\frac{2}{3} = 16\frac{2}{3}$ minutes in 160 hours

Now, $\frac{50}{3}$ minutes are gained in 160 hours.

∴ 6 minutes are gained in $160 \times \frac{3}{50} \times 6$

$$= \frac{288}{5} \text{ hours} = 57\frac{3}{5} \text{ hours.}$$

or, the watch was correct on Wednesday at 1:36 am.

**23.** **(a)** In order to hear 12 strikes, there are 11 intervals (12 − 1) and time of each interval is uniform.

Hence, time to hear each strike is $\frac{22}{11} = 2$ seconds

Now, to hear six strikes, there are 6 − 1, i.e., 5 × 2 = 10 seconds.

Hence, it will take 10 seconds for a clock to strike 6.

**24.** **(c)** 2 October 1869 means

1868 complete years + 9 months + 2 days

1600 years give 0 odd days

200 years give 3 odd days

Number of leap years in 68 years = largest integer less than $\frac{68}{4} = 17$

∴ 68 years contain 17 leap years and 51 non-leap years:

∴ 68 years have 2 × 17 + 51 = 85, i.e., 1 odd day

Also count number of days from January 1, 1869 to October 2, 1869

| January | February | March | April | May | June |
|---|---|---|---|---|---|
| 31 | + 28 | + 31 | + 30 | + 31 | + 30 |

| July | August | September | October | |
|---|---|---|---|---|
| 31 | + 31 | + 30 | + 2 | = 275 |

= 39 weeks + 2 days

∴ This gives 2 odd days

∴ Total number of odd days = 0 + 3 + 1 + 2 = 6

∴ Day on October 2, 1869 was Saturday.

**25.** **(b)** Year 2000 was a leap year.

Number of days remaining in 1999

= 365 − [31 days of January + 28 days of February + 5 days March].

= 301 days = 43 weeks, i.e., 0 odd day.

Number of days passed in 2000:

January 31 days have 3 odd days.

February 29 days (being leap year) have 1 odd day March 5 days have 5 odd days.

∴ Total number of odd days = 0 + 3 + 1 + 5 + 9 days, i.e., 2 odd days

Therefore, March 5, 2000 would be two days beyond Friday, i.e., on Sunday.

**26.** **(a)** August 1, 1988 means:

1987 years + 7 months

Number of odd days in 1987 years:

1600 years have 0 odd days

300 years have 1 odd day

87 years have 21 leap years and 66 ordinary years.

So, there are 21 × 2 + 66 × 1 = 108 days, i.e., 15 weeks and 3 odd days.

Number of days between January 1, 1988 to August 1, 1989.

| January | February | March | April | May | June | July | August | |
|---|---|---|---|---|---|---|---|---|
| 31 | + 29 | + 31 | + 30 | + 31 | + 30 | + 31 | + 1 | = |

241 days

i.e., 30 weeks and 4 odd days.

Total number of odd days = 0 + 1 + 3 + 4 = 8 odd days or 1 odd day.

Thus, Friday falls on 5th, 12th, 19th and 26th in August 1988.

**27.** **(b)** August 15, 1947 = (1600 + 300 + 46) years + January 1 to August 15th, of 1947

= (1600 + 300 + 46) years + 365 − August 16 to December. 31 1947

= (1600 + 300 + 46) years + (365 − 138) days

Number of odd days = 0 + 1 + 1 (from 11 leap years and 35 ordinary years) + 3 = 5 odd days

∴ The day was Friday.

**28.** **(a)** During the interval we have two leap years as 1992 and 1996 and it contains February of both these years.

∴ The interval has (5 + 2) = 7 odd days or 0 odd day.

Hence, January 7, 1997 was also Tuesday.

**29.** **(a)** 400 consecutive years contain 97 leap years.

∴ In 400 consecutive years February has 29 days 97 times and the remaining 11 months have 29th day

400 × 11 = 4400 times

∴ 29th day of the month occurs 4400 + 97 = 4497 times.

**30.** **(d)** Total number of odd days = 1600 years have 0 odd day + 300 years have 1 odd day + 49 years (12 leap years + 37 ordinary years) have 5 odd days + 26 days of January have 5 odd days = 0 + 1 + 5 + 5 = 4 odd days.

So, the day was Thursday.

**31.** **(a)** In an ordinary year, February has no odd day.

∴ February and March begin on same day of the week.

Also we know that, November and March begin on same day of the week.

**32.** **(c)** Number of days from January 25, 1994 to March 2, 1994 is

| January | February | March | |
|---|---|---|---|
| 6 | + 28 | + 2 | = 36 |

∴ Number of odd days = 1

∴ Day on January 25, 1994 is one day before the day on March 2, 1994.

But March 2, 1994 was on Wednesday.

∴ January 25, 1994 was on Tuesday.

**33.** (**d**) Starting with 2000, count for number of odd days in successive years till the sum is divisible by 7.

| 2000 | 2001 | 2002 | 2003 | 2004 | |
|---|---|---|---|---|---|
| 2 | + 1 | + 1 | +1 | + 2 | = 7 |

∴ Number of odd days up to 2004 = 0

∴ Calendar for 2000 will serve for 2005 also.

## Exercise-2
## (Based on Memory)

**1.** **(c)** $2(1 + 2 + 3 = \dots\dots + 12) = \dfrac{2\times12\times(12+1)}{2}$

$= 12 \times 13 = 156.$

**2.** **(b)** $\dfrac{\pi r^2}{4} = \dfrac{22}{7}\times\dfrac{1}{4}\times(7)^2 = \dfrac{154}{4} = 38.5\ \text{cm}^2.$

**4.** **(b)** The day after tomorrow is Sunday. Therefore today is Friday.

Hence, the day on tomorrow's day before yesterday is given by:

= Friday – 1 = Thursday

**5.** **(a)** Required time $= 5 \times 6 \times \dfrac{12}{11}$ minutes past 6

$= 32\dfrac{8}{11}$ minutes past 6.

**6.** **(a)** Birth date of Sashikant = September 28

Difference in number of days from August 15 to September 28

= 16 + 28 = 44

Number of odd days in 44 days = 2

Birthday of Shashikant = Tuesday.

**7.** **(c)** At 9 O'clock, the minute hand is 9 × 5 = 45 minutes space behind the hour hand. Hence, the minute hand will have to gain 45 – 30 = 10 minutes.

Therefore, 60 minutes is equal to the gain of 55 minutes spaces.

Hence, gain of 15 minutes spaces equals

$= \dfrac{60}{55}\times15 = \dfrac{180}{11} = 16\dfrac{4}{11}$

Therefore, hour and minute hands of a clock point in opposite direction after 9 O'clock at $16\dfrac{4}{11}$ minutes past 9.

**8.** **(b)** January 5th, 1965 ⇒ Tuesday

January 5th, 1966 ⇒ Wednesday

January 5th, 1967 ⇒ Thursday

January 5th, 1968 ⇒ Friday

January 5th, 1969 ⇒ Sunday

Since, 1968 is a leap year.

January 5th, 1970 ⇒ Monday

January 5th, 1971 ⇒ Tuesday

**9.** **(a)** The year 1996 was a leap year and number of days remaining in the year 1996

= 366 – 26 = 340 days

= 48 weeks = 40 odd days

The years 1997, 1998 and 1999 have 3 odd days in total. The year 2000 was also a leap year.

Days till August 15, 2000

= 31 + 29 + 31+ 30 + 31 + 30 + 31 + 15.

= 228 days

$\dfrac{228}{7}$ = 32 weeks 4 odd days

Now, total number of odd days

4 + 4 + 3 = 11 days

$\dfrac{11}{7}$ = 1 week, 4 odd days

Thus, August 15th, 2000 was 4 days beyond Friday i.e., Tuesday.

**10.** **(c)** Odd number of days from September 6, 1970 to September 6, 1981 = 14

Hence, the Sunday will be on September 6, 1981.

**11.** **(c)** In every 30 minutes the time of watch increased by 3 minutes = 12 × 3 = 36 minutes

So the time after 6 hours = 5 am + 6 hours + 30 minutes = 11.36 am.

**12.** **(b)** The wall clock gains 6 minutes in 36 hours, while table watch loses 2 minutes in 36 hours.

∴ Difference of 8 minutes is in $\dfrac{3}{2}$ days

∴ Difference of 12 hours is in

$= \dfrac{3}{2}\times\dfrac{1}{8}\times12\times60 = 135$ days

**13.** **(c)** In 1 hour it increases by 6 minutes so in 6 hours it increases by 36 minutes.

# Polynomials

# 25

## POLYNOMIAL

A function $p(x)$ of the form

$$p(x) = a_0 + a_1x + a_2x^2 + \cdots + a_nx^n$$

where $a_0$, $a_1$, $a_2$, ..., $a_n$ are real numbers, $a_n \neq 0$ and $n$ is a non-negative integer is called a *polynomial* in $x$ over reals.

The real number $a_0, a_1, ..., a_n$ are called the *coefficients of the polynomial*.

If $a_0$, $a_1$, $a_2$, ..., $a^n$ are all integers, we call it a *polynomial over integers.*

If they are rational numbers, we call it a *polynomial over rationals*.

**Illustration 1:**

(a) $4x^2 + 7x - 8$ is a polynomial over integers.

(b) $\frac{7}{4}x^3 + \frac{2}{3}x^2 - \frac{8}{7}x + 5$ is a polynomial over rationals.

(c) $4x^2 - \sqrt{3}\,x + \sqrt{5}$ is a polynomial over reals.

### Monomial

A polynomial having only one term is called a monomial. For example, 7, $2x$, $8x^3$ are monomials.

### Binomial

A polynomial having two terms is called a binomial. For example, $2x + 3$, $7x^2 - 4x$, $x^2 + 8$ are binomials.

### Trinomial

A polynomial having three terms is called a trinomial. For example, $7x^2 - 3x + 8$ is a trinomial.

### Degree of a Polynomial

The exponent in the term with the highest power is called the degree of the polynomial.

For example, in the polynomial $8x^6 - 4x^5 + 7x^3 - 8x^2 + 3$, the term with the highest power is $x^6$. Hence, the degree of the polynomial is 6.

A polynomial of degree 1 is called a *linear polynomial*.

It is of the form $ax + b$, $a \neq 0$.

A polynomial of degree 2 is called a *quadratic polynomial*.

It is of the form $ax^2 + bx + c$, $a \neq 0$.

### Division of a Polynomial by a Polynomial

Let, $p(x)$ and $f(x)$ are two polynomials and $f(x) \neq 0$. Then, if we can find polynomials $q(x)$ and $r(x)$, such that

$$p(x) = f(x) \cdot q(x) + r(x),$$

where degree $r(x)$ < degree $f(x)$, then we say that $p(x)$ divided by $f(x)$, gives $q(x)$ as *quotient* and $r(x)$ as *remainder*.

If the remainder $r(x)$ is zero, we say that *divisor* $f(x)$ is a factor of $p(x)$ and we have

$$p(x) = f(x) \cdot q(x).$$

**Illustration 2:** Divide $f(x) = 5x^3 - 70x^2 + 153x - 342$ by $g(x) = x^2 - 10x + 16$. Find the quotient and the remainder.

**Solution:**

$$\begin{array}{r|l}
 & 5x - 20 \\
\hline
x^2 - 10x + 16 & 5x^3 - 70x^2 + 153x - 342 \\
 & 5x^3 - 50x^2 + 80x \\
 & - \quad + \qquad\quad - \\
\hline
 & -20x^2 + 73x - 342 \\
 & -20x^2 + 200x - 320 \\
 & + \qquad\quad - \quad + \\
\hline
 & -127x - 22
\end{array}$$

$\therefore$ Quotient $= 5x - 20$ and

Remainder $= -127x - 22$.

**Illustration 3:** Determine if $(x - 1)$ is a factor of $p(x) = x^3 - 3x^2 + 4x + 2$.

$$
\begin{array}{r|l}
 & \quad x^2 - 2x + 2 \\ \hline
x - 1 & x^3 - 3x^2 + 4x + 2 \\
 & x^3 - x^2 \\
 & - \quad + \\ \hline
 & -2x^2 + 4x \\
 & -2x^2 + 2x \\
 & \quad - \quad + \\ \hline
 & \qquad 2x + 2 \\
 & \qquad 2x - 2 \\
 & \qquad - \quad + \\ \hline
 & \qquad\quad 4
\end{array}
$$

Since the remainder is not zero, $(x - 1)$ is not a factor of $p(x)$.

## SOME BASIC THEOREMS

**Factor Theorem**

Let, $p(x)$ be a polynomial of degree $n > 0$. If $p(a) = 0$ for a real number $a$, then $(x - a)$ is a factor of $p(x)$.
Conversely, if $(x - a)$ is a factor of $p(x)$, then $p(a) = 0$.

**Illustration 4:** Use factor theorem to determine if $(x - 1)$ is a factor of $x^8 - x^7 + x^6 - x^5 + x^4 - x + 1$.

**Solution:** Let, $p(x) = x^8 - x^7 + x^6 - x^5 + x^4 - x + 1$.

Then, $p(1) = (1)^8 - (1)^7 + (1)^6 - (1)^5 + (1)^4 - 1 + 1 = 1 \neq 0$.

Hence, $(x - 1)$ is not a factor of $p(x)$.

**Remainder Theorem**

Let, $p(x)$ be any polynomial of degree $\geq 1$ and $a$ any number.
If $p(x)$ is divided by $x - a$, the remainder is $p(a)$.

**Illustration 5:** Let, $p(x) = x^5 + 5x^4 - 3x + 7$ be divided by $(x - 1)$. Find the remainder.

**Solution:** Remainder $= p(1) = (1)^5 + 5(1)^4 - 3(1) + 7 = 10$.

## Some Useful Results and Formulae

1. $(A + B)^2 = A^2 + B^2 + 2AB$
2. $(A - B)^2 = A^2 + B^2 - 2AB = (A + B)^2 - 4AB$
3. $(A + B)(A - B) = A^2 - B^2$
4. $(A + B)^2 + (A - B)^2 = 2(A^2 + B^2)$
5. $(A + B)^2 - (A - B)^2 = 4AB$
6. $(A + B)^3 = A^3 + B^3 + 3AB(A + B)$
7. $(A - B)^3 = A^3 - B^3 - 3AB(A - B)$
8. $A^2 + B^2 = (A + B)^2 - 2AB$
9. $A^3 + B^3 = (A + B)(A^2 + B^2 - AB)$
10. $A^3 - B^3 = (A - B)(A^2 + B^2 + AB)$
11. $(A + B + C)^2 = A^2 + B^2 + C^2 + 2(AB + BC + CA)$
12. $(A^3 + B^3 + C^3 - 3ABC$
    $= (A + B + C)(A^2 + B^2 + C^2 - AB - CA - BC)$
13. $A + B + C = 0 \Rightarrow A^3 + B^3 + C^3 = 3ABC$.
14. $A^n - B^n$ is divisible by $(A - B)$ for all values of $n$.
15. $A^n - B^n$ is divisible by $(A + B)$ only for even values of $n$.
16. $A^n + B^n$ is never divisible by $(A - B)$.
17. $A^n + B^n$ is divisible by $(A + B)$ only when $n$ is odd.

## A Useful Shortcut Method

When a polynomial $f(x)$ is divided by $x - a$ and $x - b$, the respective remainders are $A$ and $B$. Then, if the same polynomial is divided by $(x - a)(x - b)$, the remainder will be

$$\frac{A - B}{a - b}x + \frac{Ba - Ab}{a - b}.$$

**Illustration 6:** When a polynomial $f(x)$ is divided by $(x-1)$ and $(x-2)$, the respective remainders are 15 and 9. What is the remainder when it is divided by

$(x-1)(x-2)$?

**Solution:** Remainder $= \frac{A-B}{a-b}x + \frac{Ba-Ab}{a-b}$

$$= \frac{15-9}{1-2}x + \frac{9(1)-15(2)}{1-2}$$

$$= (-x + 21).$$

## EXERCISE-I

**1.** If $(x-2)$ is a factor of the polynomial $x^3 - 2ax^2 + ax - 1$, then find the value of $a$.

(a) $\frac{5}{6}$ (b) $\frac{7}{6}$

(c) $\frac{11}{6}$ (d) None of these

**2.** If $x + a$ is a factor of the polynomial $x^3 + ax^2 - 2x + a + 4$, then find the value of $a$.

(a) $-\frac{4}{3}$ (b) $+\frac{2}{3}$

(c) $+\frac{4}{3}$ (d) None of these

**3.** Find the value of $k$ if $f(x) = x^3 - kx^2 + 11x - 6$ and $(x-1)$ is a factor of $f(x)$.

(a) 6 (b) 4

(c) 8 (d) None of these

**4.** If $5x^2 - 4x - 1$ is divided by $x - 1$, then the remainder is:

(a) 0 (b) 2

(c) 1 (d) None of these

**5.** Find the values of $m$ and $n$ in the polynomials $2x^3 + mx^2 + nx - 14$, such that $(x-1)$ and $(x+2)$ are its factors.

(a) $m = 4, n = 5$ (b) $m = 9, n = 3$

(c) $m = 6, n = 7$ (d) None of these

**6.** What value should $a$ possess so that $x + 1$ may be a factor of the polynomial.

$f(x) = 2x^3 - ax^2 - (2a - 3)x + 2$?

(a) 2 (b) $-2$

(c) 3 (d) None of these

**7.** Divide the polynomial $4y^3 - 3y^2 + 2y - 4$ by $y + 2$ and find the quotient and remainder.

(a) $4y^2 - 11y + 24, -52$

(b) $6y^2 - 13y + 36, -64$

(c) $4y^2 + 13y - 24, +52$

(d) None of these

**8.** Resolve into factors: $16(x-y)^2 - 9(x+y)^2$.

(a) $(x-5y)(5x-y)$ (b) $(x+7y)(7x+y)$

(c) $(x-7y)(7x-y)$ (d) None of these

**9.** Resolve into factors: $4x^2 + 12xy + 9y^2 - 8x - 12y$.

(a) $(3x+2y)(4x+2y-3)$

(b) $(2x+3y)(2x+3y-4)$

(c) $(2x-3y)(2x+3y+4)$

(d) None of these

**10.** Resolve into factors: $16x^2 - 72xy + 81y^2 - 12x + 27y$.

(a) $(6x-7y)(6x-7y-5)$

(b) $(4x-9y)(4x-9y-3)$

(c) $(4x+9y)(4x+9y+3)$

(d) None of these

**11.** Resolve into factors: $(a+b)^2 - 14c(a+b) + 49c^2$.

(a) $(a-b-9c)^3$ (b) $(a+b-7c)^2$

(c) $(a+b+9c)^2$ (d) None of these

**12.** Resolve into factors: $81x^2y^2 + 108xyz + 36z^2$.

(a) $(6xy+9z)^2$ (b) $(9xy-7z)^2$

(c) $(9xy+6z)^2$ (d) None of these

**13.** Factorize: $(a-b+c)^2 + (b-c+a)^2 + 2(a-b+c)(b+c-a)$.

(a) $4a^2$ (b) $6a^2$

(c) $8a^2$ (d) None of these

**14.** Resolve into factors: $9(3x+5y)^2 - 12(3x+5y)(2x+3y) + 4(2x+3y)^2$.

(a) $(7x+9y)^2$ (b) $(5x+9y)^2$

(c) $(5x-9y)^2$ (d) None of these

**15.** Factorize: $(2x+3y)^2 + 2(2x+3y)(2x-3y) + (2x-3y)^2$.

(a) $16x^2$ (b) $18x^2$

(c) $12x^2$ (d) None of these

**16.** Factorize: $45a^3b + 5ab^3 - 30a^2b^2$.

(a) $5ab(5a-b)^2$ (b) $7ab(5a-b)^2$

(c) $5ab(3a-b)^2$ (d) None of these

**17.** Find the factors of $(a - b)^3 + (b - c)^3 + (c - a)^3$.

(a) $3(a + b)(b + c)(c + a)$
(b) $5(a - b)(b - c)(c - a)$
(c) $3(a - b)(b - c)(c - a)$
(d) None of these

**18.** Factorize: $a^2 + \frac{1}{a^2} + 3 - 2a - \frac{2}{a}$.

(a) $\left(a + \frac{1}{a} - 1\right)\left(a - \frac{1}{a} + 1\right)$

(b) $\left(a + \frac{1}{a} - 1\right)\left(a + \frac{1}{a} + 1\right)$

(c) $\left(a + \frac{1}{a} + 1\right)\left(a + \frac{1}{a} + 1\right)$

(d) $\left(a + \frac{1}{a} - 1\right)\left(a + \frac{1}{a} - 1\right)$.

**19.** If $x + \frac{1}{x} = 2$, then find the value of $x^4 + \frac{1}{x^4}$.

(a) 2 (b) 4
(c) 6 (d) 8

**20.** If $\frac{x}{y} + \frac{y}{x} = 6$, then find the value of $\frac{x^3}{y^3} + \frac{y^3}{x^3}$.

(a) 176 (b) 198
(c) 184 (d) None of these

**21.** If $x + y + 2 = 0$, what will be the value of $\frac{x^2 + y^2 + z^2}{x^2 - yz}$?

(a) 4 (b) 6
(c) 2 (d) 8

**22.** If $\left(x^3 + \frac{1}{x^3}\right) = 52$, then the value of $x + \frac{1}{x}$ is:

(a) 4 (b) 3
(c) 6 (d) 13

**23.** If $x = 3$ and $y = 4$, then find the value of $256x^4 + 160x^2y^2 + 25y^4$.

(a) 114967 (b) 50176
(c) 103976 (d) 914976

**24.** If $x + \frac{1}{x} = 2$, then $x^3 + \frac{1}{x^3}$ is equal to:

(a) 64 (b) 14
(c) 8 (d) 2

**25.** If $\sqrt{x} + \frac{1}{\sqrt{x}} = 5$, what will be the value of $x^2 + \frac{1}{x^2}$.

(a) 927 (b) 727
(c) 527 (d) 627

**26.** If $x + \frac{1}{x} = 3$, then the value of $x^6 + \frac{1}{x^6}$ is:

(a) 927 (b) 414
(c) 364 (d) 322

**27.** Factors of $a^2 + \frac{1}{4} + a$ will be:

(a) $\left(a + \frac{1}{2}\right)\left(a - \frac{1}{2}\right)$ (b) $\left(a + \frac{1}{2}\right)^2$

(c) $\left(a + \frac{1}{2}\right)^3$ (d) $\left(a + \frac{1}{2}\right) \cdot a$

**28.** If $a + b + c = 0$, then the value of $\left(\frac{a^2}{bc} + \frac{b^2}{ca} + \frac{c^2}{ab}\right)$ is:

(a) 1 (b) 0
(c) –1 (d) 3

**29.** If $x + y + z = 9$ and $xy + yz + zx = 23$, then the value of $x^3 + y^3 + z^3 - 3xyz$ is:

(a) 108 (b) 207
(c) 669 (d) 729

**30.** If $x = \sqrt{3}$, then the value of $x^4 + 2 + \frac{1}{4x}$ will be:

(a) $\frac{9}{100}$ (b) $\frac{81}{100}$

(c) $\frac{101}{9}$ (d) $\frac{100}{9}$

**31.** If $x + \frac{1}{y} = 1$ and $y + \frac{1}{z} = 1$, find the value of $z + \frac{1}{x}$.

(a) 2 (b) 1
(c) 0 (d) 3

**32.** Resolve into factors:
$(a + b)^2 - 2(a^2 - b^2) + (a - b)^2$

(a) $6b^2$ (b) $2b^2$
(c) $4b^2$ (d) None of these

**33.** When $(x^3 - 2x^2 + px - q)$ is divided by $x^2 - 2x - 3$ the remainder is $(x - 6)$. The values of $p$ and $q$ are:

(a) $p = -2, q = -6$ (b) $p = 2, q = -6$
(c) $p = -2, q = 6$ (d) $p = 2, q = 6$

**34.** Let, $f(x) = a_0 x^n + a_1 x^{n-1} + a_2 x^{n-2} + \ldots + a_{n-1} x + a_n$, where, $a_0, a_1, a_2, \ldots, a_n$ are constants. If $f(x)$ is divided by $ax - b$, then the remainder is:

(a) $f\left(\frac{b}{a}\right)$ (b) $f\left(\frac{-b}{a}\right)$

(c) $f\left(\frac{a}{b}\right)$ (d) $f\left(\frac{-a}{b}\right)$

**35.** If $(x^{3/2} - xy^{1/2} + x^{1/2}y - y^{3/2})$ is divided by $(x^{1/2} - y^{1/2})$, then the quotient is:

(a) $x + y$ (b) $x - y$

(c) $x^{1/2} + y^{1/2}$ (d) $x^2 - y^2$

**36.** When $4x^3 - ax^2 + bx - 4$ is divided by $x - 2$ and $x + 1$, the respective remainders are 20 and −13. Find the values of $a$ and $b$.

(a) $a = 3, b = 2$ (b) $a = 5, b = 4$

(c) $a = 7, b = 6$ (d) $a = 9, b = 8$

**37.** When a polynomial $f(x)$ is divided by $x - 3$ and $x + 6$, the respective remainders are 7 and 22. What is the remainder when $f(x)$ is divided by $(x - 3)(x + 6)$?

(a) $\frac{-5}{3}x+12$ (b) $\frac{-7}{3}x+14$

(c) $\frac{-5}{3}x+16$ (d) $\frac{-7}{3}x+12$

**38.** If $(x - 1)$ is a factor of $Ax^3 + Bx^2 - 36x + 22$ and $2^B = 64^A$, find $A$ and $B$.

(a) $A = 4, B = 16$ (b) $A = 6, B = 24$

(c) $A = 2, B = 12$ (d) $A = 8, B = 16$

## Exercise-2
## (Based on Memory)

**1.** If $x = 11$, then the value of $x^5 - 12x^4 + 12x^3 - 12x^2 + 12x - 1$ is:

(a) 5 (b) 10

(c) 15 (d) 20

**[SSC, 2014]**

**2.** If $p = 99$, then the value of $p(p^2 + 3p + 3)$ is:

(a) 10000000 (b) 999000

(c) 999999 (d) 990000

**[SSC, 2014]**

| ANSWER KEYS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Exercise-1** | | | | | | | | | | | | |
| **1.** (b) | **2.** (a) | **3.** (a) | **4.** (a) | **5.** (b) | **6.** (c) | **7.** (a) | **8.** (c) | **9.** (b) | **10.** (b) | **11.** (b) | **12.** (c) | **13.** (a) |
| **14.** (b) | **15.** (a) | **16.** (c) | **17.** (c) | **18.** (d) | **19.** (a) | **20.** (b) | **21.** (c) | **22.** (a) | **23.** (b) | **24.** (d) | **25.** (c) | **26.** (d) |
| **27.** (b) | **28.** (d) | **29.** (a) | **30.** (d) | **31.** (b) | **32.** (c) | **33.** (c) | **34.** (a) | **35.** (a) | **36.** (a) | **37.** (a) | **38.** (c) | |
| **Exercise-2** | | | | | | | | | | | | |
| **1.** (b) | **2.** (c) | | | | | | | | | | | |

# EXPLANATORY ANSWERS

## EXERCISE-I

**1.** **(b)** Let, $p(x) = x^3 - 2ax^2 + ax - 1$

Since, $x - 2$ is a factor of $p(x)$, we must have $p(2) = 0$

$\therefore \quad (2)^3 - 2a(2)^2 + 2a - 1 = 0$

$\Rightarrow \quad 8 - 8a + 2a - 1 = 0$

$\Rightarrow \quad -6a = -7 \quad \Rightarrow \quad a = \dfrac{7}{6}$.

**2.** **(a)** Let, $p(x) = x^3 + ax^2 - 2x + a + 4$

Since, $x + a$, i.e., $x - (-a)$ is a factor of $p(x)$, we must have $p(-a) = 0$

$\Rightarrow \quad (-a)^3 + a(-a)^2 - 2(-a) + a + 4 = 0$

$\Rightarrow \quad -a^3 + a^3 + 2a + a + 4 = 0$

$\Rightarrow \quad 3a + 4 = 0 \quad \Rightarrow \quad a = -\dfrac{4}{3}$.

**3.** **(a)** $\because \quad (x - 1)$ is a factor of $f(x)$.

$\therefore$ By factor theorem, $f(1) = 0$

$\Rightarrow \quad (1)^3 - k(1)^2 + 11(1) - 6 = 0$

$\Rightarrow \quad 1 - k + 11 - 6 = 0$

$\Rightarrow \quad -k + 6 = 0 \quad \Rightarrow \quad k = 6$.

**4.** **(a)** $f(x) = 5x^2 - 4x - 1$

$\therefore \quad f(1) = 5(1)^2 - 4(1) - 1 = 0$.

**5.** **(b)** Let, $f(x) = 2x^3 + mx^2 + nx - 14$.

Since, $x - 1$ is a factor of $f(x)$.

$\therefore \quad f(1) = 0$ [By factor theorem]

$\Rightarrow \quad 2(1)^3 + m(1)^2 + n(1) - 14 = 0$

$\Rightarrow \quad 2 + m + n - 14 = 0 \quad \Rightarrow \quad m + n = 12$ ...(1)

Since, $x + 2$, i.e., $x - (-2)$ is factor of $f(x)$.

$\therefore \quad f(-2) = 0$ [By factor theorem]

$\Rightarrow \quad 2(-2)^3 + m(-2)^2 + n(-2) - 14 = 0$

$\Rightarrow \quad -16 + 4m - 2n - 24 = 0 \quad \Rightarrow \quad 4m - 2n - 30 = 0$

$\Rightarrow \quad 2m - n = 15$ ...(2)

Adding (1) and (2), we get $3m = 27 \quad \Rightarrow \quad m = 9$

Put $m = 9$ in (1), we get $9 + n = 12 \quad \Rightarrow \quad n = 3$.

**6.** **(c)** $f(x) = 2x^3 - ax^2 - (2a - 3)x + 2$?

If, $x + 1$, i.e., $x - (-1)$ is a factor of $f(x)$, then $f(-1) = 0$ [By factor theorem]

$\Rightarrow \quad 2(-1)^3 - a(-1)^2 - (2a - 3)(-1) + 2 = 0$

$\Rightarrow \quad -2 - a + 2a - 3 + 2 = 0$

$\Rightarrow \quad a - 3 = 0 \quad \Rightarrow \quad a = 3$.

**7.** **(a)**

$$\begin{array}{r|l} & 4y^2-11y+24 \\ \hline y+2 & 4y^3-3y^2+2y-4 \\ & 4y^3+8y^2 \\ & - \quad\; - \\ \hline & \quad -11y^2+2y-4 \\ & \quad -11y^2-22y \\ & \quad + \quad\;\; + \\ \hline & \quad 24y-4 \\ & \quad 24y+48 \\ & \quad - \quad - \\ \hline & \quad -52 \end{array}$$

$\therefore$ Quotient $= 4y^2 - 11y + 24$

Remainder $= -52$.

**8.** **(c)** $16(x - y)^2 - 9(x + y)^2$

$= [4(x - y)]^2 - [3(x + y)]^2$

$= [4(x - y) - 3(x + y)][4(x - y) + 3(x + y)]$

$= (4x - 4y - 3x - 3y)(4x - 4y + 3x + 3y)$

$= (x - 7y)(7x - y)$.

**9.** **(b)** $4x^2 + 12xy + 9y^2 - 8x - 12y$

$= [(2x)^2 + 2(2x)(3y) + (3y)^2] - 4(2x + 3y)$

$= (2x + 3y)^2 - 4(2x + 3y)$

$= (2x + 3y)(2x + 3y - 4)$.

**10.** **(b)** $16x^2 - 72xy + 81y^2 - 12x + 27y$

$= (4x)^2 - 2(4x)(9y) + (9y)^2] - 3(4x - 9y)$

$= (4x - 9y)^2 - 3(4x - 9y)$

$= (4x - 9y)(4x - 9y - 3)$.

**11.** **(b)** $(a + b)^2 - 14c(a + b) + 49c^2$

$= (a + b)^2 - 2(a + b)\cdot(7c) + (7c)^2$

$= (a + b - 7c)^2$.

**12.** **(c)** $81x^2y^2 + 108xyz + 36z^2$

$= (9xy)^2 + 2(9xy)(6z) + (6z)^2$

$= (9xy + 6z)^2$

**13. (a)** $(a-b+c)^2+(b-c+a)^2+2(a-b+c)(b+c-a)$

$= (a-b+c)^2+2(a-b+c)(b+c-a)$

$+(b-c+a)^2$ [rearranging]

$= [(a-b+c)+(b-c+a)]^2 = (2a)^2 = 4a^2.$

**14. (b)** $9(3x+5y)^2-12(3x+5y)(2x+3y)+4(2x+3y)^2$

$= [3(3x+5y)]^2-2[3(3x+5y)][2(2x+3y)]+[2(2x+3y)]^2$

$= [3(3x+5y)-2(2x+3y)]^2$

$= (9x+15y-4x-6y)^2 = (5x+9y)^2.$

**15. (a)** $(2x+3y)^2+2(2x+3y)(2x-3y)+(2x-3y)^2$

$= [(2x+3y)+(2x-3y)]^2 = (4x)^2 = 16x^2.$

**16. (c)** $45a^3b+5ab^3-30a^2b^2$

$= 5ab[9a^2+b^2-6ab]$

$= 5ab[9a^2-6ab+b^2]$

$= 5ab[(3a)^2-2(3a)(b)+(b)^2]$

$= 5ab[3a-b]^2.$

**17. (c)** Suppose, $a-b=x$, $b-c=y$, $c-a=z$

$\therefore\ (a-b)+(b-c)+(c-a)=x+y+z$

$\Rightarrow\ 0=x+y+z$

$\therefore\ x+y=-z$ ...(1)

$\therefore\ (x+y)^3=(-z)^3$

or, $x^3+y^3+3xy(x+y)=-z^3$

or, $x^3+y^3+z^3+3xy(-z)=-z^3$

[On substituting $x+y=-z$ from Equation (1)]

or, $x^3+y^3-3xyz=-z^3$

or, $x^3+y^3+z^3=3xyz$

$\therefore\ (a-b)^3+(b-c)^3+(c-a)^3$

$= 3(a-b)(b-c)(c-a)$

**18. (d)** $a^2+\dfrac{1}{a^2}+3-2a-\dfrac{2}{a}$

$$=\left(a^2+\frac{1}{a^2}+2\right)-2a-\frac{2}{a}+1$$

$$=\left(a+\frac{1}{a}\right)^2-2\left(a+\frac{1}{a}\right)+1$$

$= x^2-2x+1$ $\left[\text{suppose } a+\dfrac{1}{a}=x\right]$

$= (x-1)^2$

$$=\left(a+\frac{1}{a}-1\right)^2.$$

**19. (a)** $x+\dfrac{1}{x}=2 \Rightarrow \left(x+\dfrac{1}{x}\right)^2=(2)^2$

$$\therefore\ x^2+\frac{1}{x^2}+2x\cdot\frac{1}{x}=4 \Rightarrow x^2+\frac{1}{x^2}+2=4$$

$$\Rightarrow\ x^2+\frac{1}{x^2}=2$$

$$\therefore\ \left(x^2+\frac{1}{x^2}\right)^2=(2)^2 \Rightarrow x^4+\frac{1}{x^4}+2x^2\cdot\frac{1}{x^2}=4$$

$$\Rightarrow\ x^4+\frac{1}{x^4}+2=4$$

$$\therefore\ x^4+\frac{1}{x^4}=2.$$

**20. (b)** $\dfrac{x}{y}+\dfrac{y}{x}=6 \Rightarrow \left(\dfrac{x}{y}+\dfrac{y}{x}\right)^3=(6)^3$

$$\therefore\ \frac{x^3}{y^3}+\frac{y^3}{x^3}+3\left(\frac{x}{y}+\frac{y}{x}\right)=216$$

$$\therefore\ \frac{x^3}{y^3}+\frac{y^3}{x^3}+3\times 6=216$$

$$\therefore\ \frac{x^3}{y}+\frac{y^3}{x^3}=216-18=198.$$

**21. (c)** $\because\ x+y+z=0 \Rightarrow (x+y+z)^2=0$

$\therefore\ x^2+y^2+z^2+2(xy+yz+zx)=0$

$\therefore\ x^2+y^2+z^2=-2(xy+yz+zx)$

$= -2[x(y+z)+yz]$

$= -2(x\times -x+yz)$

$(\because\ x+y+z=0)$

$= 2(x^2-yz)$

$$\therefore\ \frac{x^2+y^2+z^2}{x^2-yz}=2.$$

**22. (a)** $\left(x+\dfrac{1}{x}\right)^3=\left(x^3+\dfrac{1}{x^3}\right)+3\left(x+\dfrac{1}{x}\right)$

$$\therefore\ \left(x+\frac{1}{x}\right)^3-3\left(x+\frac{1}{x}\right)=x^3+\frac{1}{x^3}=52$$

$\Rightarrow\ y^3-3y=52$ where, $y=x+\dfrac{1}{x}$

i.e., $y^3-3y-52=0$

Clearly $y=4$, satisfies $y^3-3y-52=0$

$$\therefore\ x+\frac{1}{x}=4.$$

**23. (b)** $256x^4 + 160x^2y^2 + 25y^4$

$= (16x^2)^2 + 2.16x^2 \times 5y^2 + (5y^2)^2$

$= (16x^2 + 5y^2)^2$

On substituting $x = 3$ and $y = 4$

$(16x^2 + 5y^2)^2 = (16 \times 3^2 + 5 \times 4^2)^2$

$= (16 \times 9 + 5 \times 16)^2$

$= (144 + 80)^2 = (224)^2$

$= 50176.$

**24. (d)** $x + \frac{1}{x} = 2 \Rightarrow \left(x + \frac{1}{x}\right)^3 = 23$

$\Rightarrow x^3 + \frac{1}{x^3} + 3\left(x + \frac{1}{x}\right) = 8$

$\Rightarrow x^3 + \frac{1}{x^3} + 3 \times 2 = 8$

$\Rightarrow x^3 + \frac{1}{x^3} = 2.$

**25. (c)** $\sqrt{x} + \frac{1}{\sqrt{x}} = 5 \Rightarrow \left(\sqrt{x} + \frac{1}{\sqrt{x}}\right)^2 = (5)^2$

$\therefore x + 2 \cdot \sqrt{x} \cdot \frac{1}{\sqrt{x}} + \frac{1}{x} = 25$

$\therefore 2 + x + \frac{1}{x} = 25 \Rightarrow x + \frac{1}{x} = 23$

$\therefore \left(x + \frac{1}{x}\right)^2 = (23)^2 \Rightarrow x^2 + \frac{1}{x^2} + 2 = 529$

$\Rightarrow x^2 + \frac{1}{x^2} = 527.$

**26. (d)** $\left(x + \frac{1}{x}\right)^2 = 3^2 \Rightarrow x^2 + \frac{1}{x^2} = 7$

$\Rightarrow \left(x^2 + \frac{1}{x^2}\right)^3 = 7^3$

$\therefore x^6 + \frac{1}{x^6} + 3\left(x^2 + \frac{1}{x^2}\right) = 343$

$\Rightarrow x^6 + \frac{1}{x^6} + 3 \times 7 = 343$

$\therefore x^6 + \frac{1}{x^6} = 343 - 21 = 322.$

**27. (b)** $a^2 + \frac{1}{4} + a = a^2 + \left(\frac{1}{2}\right)^2 + 2 \cdot a\left(\frac{1}{2}\right)$

$= \left(a + \frac{1}{2}\right)^2.$

**28. (d)** $a + b + c = 0 \Rightarrow a^3 + b^3 + c^3 = 3abc$

$\therefore \frac{a^3}{abc} + \frac{b^3}{abc} + \frac{c^3}{abc} = 3$ or, $\frac{a^2}{bc} + \frac{b^2}{ac} + \frac{c^2}{ab} = 3.$

**29. (a)** $x^3 + y^3 + z^3 - 3xyz$

$= (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$

$= (x + y + z)[(x + y + z)^2 - 3(xy + yz + zx)]$

$= 9[(9)^2 - 3(23)] = 9[81 - 69]$

$= 9 \times 12 = 108.$

**30. (d)** $x^4 + 2 + \frac{1}{x^4} = (x^2)^2 + 2 \cdot x^2 \cdot \frac{1}{x^2} + \left(\frac{1}{x^2}\right)^2$

$= \left(x^2 + \frac{1}{x^2}\right)^2$

$\therefore$ On substituting $x = \sqrt{3}$

$= \left[(\sqrt{3})^2 + \frac{1}{(\sqrt{3})^2}\right]^2$

$= \left(3 + \frac{1}{3}\right)^2 = \left(\frac{10}{3}\right)^2$

$= \frac{100}{9}.$

**31. (b)** $x + \frac{1}{y} = 1 \Rightarrow x = 1 - \frac{1}{y} = \frac{y-1}{y}$

$\Rightarrow \frac{1}{x} = \frac{y}{y-1}$

and, $y + \frac{1}{z} = 1 \Rightarrow \frac{1}{z} = 1 - y \Rightarrow z = \frac{1}{1-y}$

$\therefore z + \frac{1}{x} = \frac{1}{1-y} + \frac{y}{y-1} = \frac{1}{1-y} - \frac{y}{1-y}$

$= \frac{1-y}{1-y} = 1.$

**32. (c)** $(a + b)^2 - 2(a^2 - b^2) + (a - b)^2$

$= (a + b)^2 - 2(a + b)(a - b) + (a - b)^2$

$= \{(a + b) - (a - b)\}^2 = (2b)^2 = 4b^2.$

**33.** **(c)** On actual division, remainder is $(p + 3)x - q$.

$\therefore \quad (p + 3)x - q = x - 6 \quad \Rightarrow \quad p + 3 = 1$ and $q = 6$

$\Rightarrow \quad p = -2,\ q = 6.$

**34.** **(a)** $ax - b = 0 \;\Rightarrow\; x = \dfrac{b}{a}$

So, $\quad$ remainder $= f\left(\dfrac{b}{a}\right).$

**35.** **(a)** $x^{3/2} - xy^{1/2} + x^{1/2}y - y^{3/2}$

$= x(x^{1/2} - y^{1/2}) + y(x^{1/2} - y^{1/2})$

$= (x + y)(x^{1/2} - y^{1/2})$

$\therefore \quad \dfrac{x^{3/2} - xy^{1/2} + x^{1/2}y - y^{3/2}}{x^{1/2} - y^{1/2}} = (x + y).$

**36.** **(a)** Let, $f(x) = 4x^3 - ax^2 + bx - 4$. When the expression $f(x)$ is divided by $x - 2$, the remainder is

$f(2) = 4(2)^3 - a(2)^2 + b(2) - 4 = 20$ (given)

$2b - 4a + 28 = 20 \quad \Rightarrow \quad 2a - b = 4$ (1)

Similarly, when the expression $f(x)$ is divided by $x - (-1)$, the remainder is

$f(-1) = 4 \times (-1)^3 - a(-1) + b(-1) - 4 = -13$ (given)

$\Rightarrow \quad -4 - a - b - 4 = -13$

$\Rightarrow \quad a + b = 5$ …(2)

Solving (1) and (2), we get

$a = 3,\ b = 2.$

**37.** **(a)** The function $f(x)$ is not known

Here, $a = 3,\ b = -6$

$A = 7,\ B = 22$

Required remainder

$$= \frac{A - B}{a - b}x + \frac{Ba - Ab}{a - b}$$

$$= \frac{7 - 22}{3 - (-6)}x + \frac{22 \times 3 - 7 \times (-6)}{3 - (-6)}$$

$$= -\frac{5}{3}x + 12.$$

**38.** **(c)** Since $x - 1$ is a factor of $Ax^3 + Bx^2 - 36x + 22$

$\therefore \quad A(1)^3 + B(1)^2 - 36(1) + 22 = 0 \quad \Rightarrow \quad A + B = 14$

and, $2B = (2^6)A \quad \Rightarrow \quad B = 6A$

$\therefore \quad A = 2,\ B = 12.$

## Exercise-2
## (Based on Memory)

**1.** **(b)** $x = 11$ (Given)

$\therefore \quad x^5 - 12x^4 + 12x^3 - 12x^2 + 12x - 1$

$= x^5 - (11+1)x^4 + (11+1)x^3 - (11+1)x^2 + (11+1)x - 1$

$= x^5 - 11x^4 - x^4 + 11x^3 + x^3 - 11x^2 - x^2 + 11x + x - 1$

When $x = 11$,

$= 11^5 - 11^5 - 11^4 + 11^4 + 11^3 - 11^3 - 11^2 + 11^2 + 11 - 1 = 10$

**2.** **(c)** $p = 99$ (Given)

$\therefore \quad p(p^2 + 3p + 3) = p^3 + 3p^2 + 3p$

$= p^3 + 3p^2 + 3p + 1 - 1$

$= (p + 1)^3 - 1 = (99 + 1)^3 - 1$

$= (100)^3 - 1 = 999999$

# H.C.F. and L.C.M. of Polynomials

# 26

## INTRODUCTION

We have already learnt in Chapter 2 how to find the greatest common divisor (G.C.D.) or highest common factor (H.C.F.) and least common multiple (L.C.M.) of two integers. In this chapter, we will study how to find the G.C.D. and L.C.M. of polynomials which have integral coefficients.

### Divisor

A polynomial $d(x)$ is said to be a divisor of polynomial $p(x)$ if $d(x)$ is a factor of $p(x)$, i.e., $p(x)$ can be written as $p(x) = d(x)\ q(x)$, where $q(x)$ is a polynomial.

For example, $(x - 2)$ is a divisor of the polynomial $(x - 2)^3(x + 3)$.

### Common Divisor

A polynomial $d(x)$ is said to be a common divisor of the polynomials $p(x)$ and $q(x)$, if $d(x)$ is a factor of each of $p(x)$ and $q(x)$.

For example, $(x + 4)$ is a common divisor of the polynomials $(x + 4)^3\ (x - 2)\ (x + 3)$ and $(x + 4)\ (x - 2)^3\ (x + 5)$.

### G.C.D. (H.C.F) of Two Polynomials

The G.C.D. of two polynomials $p(x)$ and $q(x)$ is the common divisor which has highest degree among all common divisors and which has the highest degree term coefficient as positive.

**Illustration 1:** Find the G.C.D. of $(3x - 2)\ (4x + 3)$; $(3x - 2)^2\ (2x + 5)$.

**Solution:** Here we find that $(3x - 2)$ is a polynomial which is a common divisor and has highest degree among all common divisors. Further, the coefficient of the highest degree term $(3x)$ is 3 which is positive. Hence, $(3x - 2)$ is the G.C.D. of the given polynomial.

**G.C.D. by Factorization Method**

**Step 1** Resolve the given polynomials $p(x)$ and $q(x)$ in the complete factored form.

**Step 2** Find the G.C.D. of the numerical factors of $p(x)$ and $q(x)$.

**Step 3** Find the factors of highest degree common to the two polynomials $p(x)$ and $q(x)$.

**Step 4** The product of all such common factors and the G.C.D. of the numerical factors is the G.C.D. of the two given polynomials $p(x)$ and $q(x)$.

**Illustration 2:** Find the G.C.D. of $4 + 9x - 9x^2$ and $9x^2 - 24x + 16$.

**Solution:** We have the factorization

$$\begin{aligned} p(x) &= 4 + 9x - 9x^2 = -(9x^2 - 9x - 4) \\ &= -(9x^2 - 12x + 3x - 4) \\ &= -(3x\ (3x - 4) + 1\ (3x - 4)) \\ &= -(3x + 1)\ (3x - 4) \\ q(x) &= 9x^2 - 24x + 16 = (3x - 4)^2. \end{aligned}$$

$\because$ G.C.D. of numerical factors = 1

and the highest degree common divisor = $(3x - 4)$,

$\therefore$ Required G.C.D. = $(3x - 4)$.

**Illustration 3:** Find the G.C.D. of $8(x^4 + x^3 + x^2)$ and $20\ (x^3 - 1)$.

**Solution:** Here, $p(x) = 8\ (x^4 + x^3 + x^2)$
$= 2^3 \cdot x^2 \cdot (x^2 + x + 1)$.

$q(x) = 20\ (x^3 - 1) = 2^2 \cdot 5 \cdot (x - 1) \cdot (x^2 + x + 1)$.

$\because$ G.C.D. of numerical factors = $2^2$

and the highest degree common divisor = $x^2 + x + 1$,

$$\therefore \text{ Required G.C.D.} = 2^2\ (x^2 + x + 1) = 4\ (x^2 + x + 1).$$

## L.C.M. of Two Polynomials

We know that if $a$ and $b$ are two natural numbers, the product of $a$ and $b$ is equal to the product of their G.C.D. and L.C.M., i.e.,

$a \times b$ = (G.C.D. or H.C.F. of $a$ and $b$)$\cdot$(L.C.M. of $a$ and $b$)

or, L.C.M. of $a$ and $b$ = $\dfrac{a \times b}{\text{G.C.D. of } a \text{ and } b}$

Similarly, if $p(x)$ and $q(x)$ are two polynomials, then

L.C.M. of $p(x)$ and $q(x)$ = $\dfrac{p(x) \times q(x)}{\text{G.C.D. of } p(x) \text{ and } q(x)}$

Thus, L.C.M. of two polynomials

$$= \frac{\text{Product of two polynomials}}{\text{G.C.D. of the two polynomials}}$$

*Note:*

L.C.M. of two or more given polynomials is a polynomial of smallest degree which is divided by each one of the given polynomials.

**L.C.M. by Factorization Method**

**Step 1** Resolve the given polynomials $p(x)$ and $q(x)$ in the complete factored form.

**Step 2** The required L.C.M. is the product of each factor of $p(x)$ and $q(x)$ and if a factor is common, we take that factor which has the highest degree in $p(x)$ or $q(x)$.

**Illustration 4:** Find the L.C.M. of the polynomials

$(x + 2)^2 (x - 1) (x + 4)^2$

and, $(x + 4)^3 (x + 2) (x + 7)$

**Solution:** We have, $p(x) = (x + 2)^2 (x - 1) (x + 4)^2$

$q(x) = (x + 4)^3 (x + 2) (x + 7)$

Take the highest powers of factors common to both $p(x)$ and $q(x)$ and remaining terms for L.C.M.

$\therefore$ L.C.M. $= (x + 4)^3 (x + 2)^2 (x - 1) (x + 7)$

**Illustration 5:** Find the L.C.M. of the polynomials $(2x^2 - 3x - 2)$ and $(x^3 - 4x^2 + 4x)$.

**Solution:** We have, $p(x) = 2x^2 - 3x - 2$

$= (x - 2) (2x + 1)$

$q(x) = x^3 - 4x^2 + 4x = x(x^2 - 4x + 4) = x(x - 2)^2.$

$\therefore$ H.C.F. $= (x - 2)$

Hence, L.C.M. $= \dfrac{p(x) \cdot q(x)}{\text{H.C.F.}} = \dfrac{x(x-2)^3.(2x+1)}{(x-2)}$

$= x(x - 2)^2 (2x + 1).$

or, Taking the highest powers of factors common to both $p(x)$ and $q(x)$ and remaining terms for L.C.M., we have

L.C.M. $= x(x - 2)^2 (2x + 1).$

## Exercise-I

**1.** Find the G.C.D. of $3 + 13x - 30x^2$; $25x^2 - 30x + 9$.

(a) $7x - 4$ (b) $5x - 3$
(c) $6x - 5$ (d) None of these

**2.** Find the L.C.M. of the polynomials.
$(x + 3)^2 (x - 2) (x + 1)^2$; $(x + 1)^3 (x + 3) (x + 4)$.

(a) $(x + 3) (x + 1)^2 (x + 4)$
(b) $(x + 3)^2 (x + 1) (x - 2)$
(c) $(x + 3)^2 (x + 1)^3 (x - 2) (x + 4)$
(d) None of these.

**3.** Find the L.C.M. of the polynomials:
$2x^2 - 3x - 2$; $x^3 - 4x^2 + 4x$.

(a) $x(x - 2)^2 (2x + 1)$
(b) $x(x - 2) (2x + 1)^2$
(c) $x(x - 2) (2x + 1)$
(d) None of these.

**4.** Find the G.C.D. of $8(x^3 - x^2 + x)$; $28 (x^3 + 1)$.

(a) $6(x^2 + x - 1)$ (b) $4(x^2 - x + 1)$
(c) $8(x^2 + 2x - 1)$ (d) None of these

**5.** Find the G.C.D. of $4x^4 + y^4$, $2x^3 - xy^2 - y^3$ and $2x^2 + 2xy + y^2$.

(a) $2x^2 + 2xy + y^2$ (b) $2x^3 + 4xy + y^2$
(c) $3x^2 + 2xy + y^2$ (d) None of these

**6.** Find the G.C.D. of $(x + 4)^2 (x - 3)^2$ and $(x - 1) (x + 4) (x - 3)^2$.

(a) $(x + 3) (x + 9)^2$ (b) $(x + 4) (x - 3)^3$
(c) $(x + 4) (x - 3)^2$ (d) None of these

**7.** Find the L.C.M. of the polynomials.
$16 - 4x^2$; $x^2 + x - 6$.

(a) $-4(x^2 - 4) (x + 3)$ (b) $6(x^2 - 4) (x + 4)$
(c) $8(x^2 - 6) (x + 3)$ (d) None of these

**8.** Find the G.C.D. of $x^2 - 4$ and $x^3 - 5x + 6$.

(a) $x - 3$ (b) $x - 2$
(c) $x + 4$ (d) None of these

**9.** The H.C.F. (Highest Common Factor) of two Polynomials is $(y - 7)$ and their L.C.M. is $y^3 - 10y^2 + 11y + 70$. If one of the polynomials is $y^2 - 5y - 14$, find the other.

(a) $y^2 - 12y + 35$ (b) $y^2 - 8y + 35$
(c) $y^2 - 14y + 45$ (d) None of these

**10.** If $(x - 4)$ is the G.C.D. of $x^2 - x - 12$ and $x^2 - mx - 8$, find the value of $m$.

(a) 4 (b) 6
(c) 2 (d) None of these

**11.** Find the G.C.D. of the polynomials

$(x - 2)^2 (x + 3) (x - 4)$; $(x - 2) (x + 2) (x - 5)$.

(a) $(x - 4)$ (b) $(x - 6)$
(c) $(x - 2)$ (d) None of these

**12.** For what value of $a$, the G.C.D. of $x^2 - 2x - 24$ and $x^2 - ax - 6$ is $(x - 6)$?

(a) 7 (b) 5
(c) 9 (d) None of these

**13.** The L.C.M. and H.C.F. of two polynomials $p(x)$ and $q(x)$ are $36x^3(x + \text{a}) (x^3 - a^3)$ and $x^2(x - a)$, respectively. If $p(x) = 4x^2 (x^2 - a^2)$, find $q(x)$.

(a) $12x^3(x^3 - a^3)$ (b) $6x^3(x^3 - a^3)$
(c) $9x^3(x^3 - a^3)$ (d) None of these

**14.** If $(x - a)$ is the G.C.D. of $x^2 - x - 6$ and $x^2 + 3x - 18$, find the value of $a$.

(a) 3 (b) 6
(c) 9 (d) None of these

**15.** The G.C.D and L.C.M. of two polynomials $p(x)$ and $q(x + a)$ and $12x^2(x + a) (x^2 - a^2)$, respectively. If $p(x) = 4x (x + a)^2$, find $q(x)$.

(a) $3x^2(x^2 - a^2)$ (b) $5x^2(x^3 - a^3)$
(c) $4x^2(x^2 - a^2)$ (d) None of these

**16.** Find the G.C.D. of $8(x^4 - 16)$ and $12(x^3 - 8)$.

(a) $6(x - 2)$ (b) $4(x - 2)$
(c) $8(x - 2)$ (d) None of these

**17.** Find the L.C.M. of the polynomials $(x + 3) (-6x^2 + 5x + 4)$; $(2x^2 + 7x + 3) (x + 3)$.

(a) $-(x + 3)^2(3x - 4)(2x + 1)$
(b) $(x + 3)^2(3x - 4)(2x + 1)$
(c) $(x + 3)^2(3x + 4)(2x + 1)$
(d) None of these

**18.** Find the G.C.D. of the polynomials $36x^2 - 49$ and $6x^2 - 25x + 21$.

(a) $8x - 9$ (b) $9x - 5$
(c) $6x - 7$ (d) None of these

**19.** Find the L.C.M. of the polynomials:

$30x^2 + 13x - 3$; $25x^2 - 30x + 9$.

(a) $-(5x - 3)^2 (5x + 3) (6x - 1)$
(b) $(5x - 3)^2 (5x + 3) (6x - 1)$
(c) $(5x + 3)^2 (6x - 1)$
(d) None of these

**20.** Find the G.C.D. of the polynomials $6x^2 + 11x$ and $2x^2 + x - 3$.

(a) $4x + 5$ (b) $2x - 3$
(c) $2x + 3$ (d) None of these

**21.** The H.C.F of two expressions $p$ and $q$ is 1. Their L.C.M. is:

(a) $(p + q)$ (b) $(p - q)$
(c) $p\,q$ (d) $\dfrac{1}{pq}$

**22.** The H.C.F. of $(2x^2 - 4x)$, $(3x^4 - 12x^2)$ and $(2x^5 - 2x^4 - 4x^3)$ is:

(a) $2x(x + 2)$ (b) $2x(2 - x)$
(c) $2x(x - 2)$ (d) $x(x - 2)$

**23.** The product of two non-zero expressions is $(x + y + z)p^3$. If their H.C.F. is $p^2$, their L.C.M. is:

(a) $(x + y)p$ (b) $(y + 2)p$
(c) $(z + x)p$ (d) $(x + y + z)p$

**24.** If $(x - 1)$ is the H.C.F. of $(x^2 - 1)$ and $(px^2 - q)$ $(x + 1)$ then:

(a) $p = 2q$ (b) $q = 2p$
(c) $3p = 2q$ (d) $2p = 3p$

**25.** The L.C.M. of $(x^2 - y^2)$, $(x^3 - y^3)$, $(x^3 - x^2y - xy^2 + y^3)$ is:

(a) $(x + y) (x - y) (x^2 + y^2 + xy)$
(b) $(x + y) (x - y)^2 (x^2 + y^2 + xy)$
(c) $(x + y) (x - y)^2 (x^2 + y^2 - xy)$
(d) $(x + y)^2 (x - y)^2$

## ANSWER KEYS

### EXERCISE-I

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (c) | **3.** (a) | **4.** (b) | **5.** (a) | **6.** (c) | **7.** (a) | **8.** (b) | **9.** (a) | **10.** (c) | **11.** (c) | **12.** (b) | **13.** (c) |
| **14.** (a) | **15.** (a) | **16.** (b) | **17.** (a) | **18.** (c) | **19.** (b) | **20.** (c) | **21.** (c) | **22.** (d) | **23.** (d) | **24.** (a) | **25.** (b) | |

# EXPLANATORY ANSWERS

## EXERCISE-I

**1.** **(b)** Here,
$p(x) = 3 + 13x - 30x^2 = 3 + 18x - 5x - 30x^2$
$= 3(1 + 6x) - 5x(1 + 6x)$
$= (3 - 5x)(1 + 6x)$
$= -(5x - 3)(1 + 6x)$
$q(x) = 25x^2 - 30x + 9 = (5x - 3)^2$
$\therefore$ G.C.D. of numerical factors = 1 and highest degree of common division.
$= (5x - 3)$ = G.C.D.

**2.** **(c)** $p(x) = (x + 3)^2 (x - 2)(x + 1)^2$
$q(x) = (x + 1)^3 (x + 3)(x + 4)$
$\therefore$ L.C.M. $= (x + 3)^2 (x + 1)^3 (x - 2)(x + 4)$.

**3.** **(a)** We have,
$p(x) = 2x^2 - 3x - 2 = 2x^2 - 4x + x - 2$
$= 2x(x - 2) + 1(x - 2) = (2x + 1)(x - 2)$
$q(x) = x^3 - 4x^2 + 4x = x(x^2 - 4x + 4) = x(x - 2)^2$
$\therefore$ L.C.M. $= x(x - 2)^2 (2x + 1)$.

**4.** **(b)** We have the factorization
$p(x) = 8(x^3 - x^2 + x) = 2^3 . x . (x^2 - x + 1)$
$q(x) = 28(x^3 + 1) = 2^2 .7. (x + 1)(x^2 - x + 1)$
$\therefore$ G.C.D. of numerical factors $= 2^2$ and, the highest degree common divisor $= x^2 - x + 1$.
Therefore, required G.C.D. $= 2^2(x^2 - x + 1)$
$= 4(x^2 - x + 1)$.

**5.** **(a)** 1st Expression $= (2x^2 + y^2)^2 - (2xy)^2$
$= (2x^2 + y^2 + 2xy)(2x^2 + y^2 - 2xy)$
2nd Expression $= (2x^3 - 2y^3) - y^2(x - y)$
$= 2(x - y)(x^2 + xy + y^2) -y^2)(x - y)$
$= (x - y)(2x^2 + 2xy + 2y^2 - y^2)$
$= (x - y)(2x^2 + 2xy + y^2)$
Hence, G.C.D. $= 2x^2 + 2xy + y^2$.

**6.** **(c)** Let, $p(x) = (x + 4)^2 (x - 3)^2$ and $q(x) = (x - 1)(x + 4)(x - 3)^2$
The highest degree common divisor is $(x + 4)(x - 3)^2$
$\therefore$ The G.C.D. of given polynomial is $(x + 4)(x - 3)^2$.

**7.** **(a)** We have,
$p(x) = 16 - 4x^2 = 4(4 - x^2)$
$= 4(2 - x)(2 + x) = -4(x - 2)(x + 2)$
$q(x) = x^2 + x - 6 = x^2\ 3x - 2x - 6$
$= x(x + 3) - 2(x + 3) = (x + 3)(x - 2)$.
$\therefore$ L.C.M. $= -4(x - 2)(x + 2)(x + 3)$
$= -4(x^2 - 4)(x + 3)$.

**8.** **(b)** Let, $p(x) = x^2 - 4 = x^2 - 2^2$
$= (x + 2)(x - 2)$
And, $q(x) = x^2 - 5x + 6 = x^2 - 2x - 3x + 6$
$= x(x - 2) - 3(x - 2) = (x - 2)(x - 3)$.
The highest degree common divisor is $x - 2$.
$\therefore$ The G.C.D. of $p(x)$ and $q(x)$ is $x - 2$.

**9.** **(a)** H.C.F. $= (y - 7)$
L.C.M. $= y^3 - 10y^2 + 11y + 70$
$p(x) = y^2 - 5y - 14$
$q(x) = ?$
L.C.M. of two polynomials

$$= \frac{\text{Ist Polynomial} \times \text{IInd Polynomial}}{\text{H.C.F. of two polynomials}}$$

$$\therefore \text{ L.C.M.} = \frac{p(x)\,q(x)}{\text{H.C.F.}}$$

$$y^3 - 10y^2 + 11y + 70 = \frac{(y^2 - 5y - 14) \times q(x)}{(y - 7)}$$

$$\therefore\ q(x) = \frac{(y - 7)(y^3 - 10y^2 + 11y + 70)}{(y^2 - 5y - 14)}$$

$= (y - 7)(y - 5)$
$= y^2 - 12y + 35$.

**10.** **(c)** H.C.F. $= (x - 4)$
$p(x) = x^2 - x - 12 = (x - 4)(x + 3)$
$q(x) = x^2 - mx - 8$
As $(x - 4)$ is common in $p(x)$ and $q(x)$. Hence, $x - 4$ should be a factor of $x^2 - mx - 8$.

Thus, putting $(x - 4) = 0$ in $q(x)$, we get (Remainder theorem)
$q(x) = x^2 - mx - 8$
$q(4) = 4^2 - m \times 4 - 8 = 0 \Rightarrow 16 - 4m - 8 = 0$
$\Rightarrow m = 2$.

**11.** **(c)** Let, $p(x) = (x - 2)^2 (x + 3) (x - 4)$
and, $q(x) = (x - 2) (x + 2) (x - 5)$
the highest degree common divisor of the given polynomials is $x - 2$.
$\therefore$ The G.C.D. is $x - 2$.

**12.** **(b)** Here, $p(x) = x^2 - 2x - 24$
and, $q(x) = x^2 - ax - 6$
Since $(x - 6)$ is the G.C.D. of $p(x)$ and $q(x)$,
$(x - 6)$ is a factor of $p(x)$ and $q(x)$ both
$\Rightarrow p(6) = q(6)$
$\Rightarrow 36 - 2 \times 6 - 24 = 36 - a \times 6 - 6$
$\Rightarrow a = 5$.

**13.** **(c)** We know that,
$p(x) \times q(x) = \text{L.C.M.} \times \text{H.C.F.}$
$4x^2(x^2 - a^2) \times q(x) = 36\, x^3(x + a)\, (x^3 + a^3)\, x^2(x - a)$

$$\Rightarrow \quad q(x) = \frac{36x^5(x^2 - a^2)(x^3 - a^3)}{4x^2(x^2 - a^2)} = 9x^3(x^3 - a^3).$$

**14.** **(a)** Let, $p(x) = x^2 - x - 6$
and, $q(x) = x^2 + 3x - 18$
Since $(x - a)$ is the G.C.D. of $p(x)$ and $q(x)$,
$(x - a)$ is a divisor of $p(x)$ and $q(x)$ or $(x - a)$ is a Factor of $p(x)$ and $q(x)$ both.
$\Rightarrow p(a) = 0$ and $q(a) = 0 \Rightarrow p(a) = q(a)$
$\Rightarrow a^2 - a - 6 = a^2 + 3a - 18$
$\Rightarrow 4a = 12 \Rightarrow a = 3$.

**15.** **(a)** $q(x) = \dfrac{\text{L.C.M.} \times \text{H.C.F.}}{p(x)}$

$$= \frac{12x^2(x+a)(x^2 - a^2)x(x+a)}{4x(x+a)^2}$$

$= 3x^2(x^2 - a^2)$.

**16.** **(b)** $p(x) = 8(x^4 - 16)$
$= 4\times2(x^2 + 4)\, (x + 2)\, (x - 2)$
$q(x) = 12(x^3 - 8)$
$= 4 \times 3(x - 2)\, (x^2 + 2x + 4)$
Hence, G.C.D. $= 4(x - 2)$.

**17.** **(a)** $p(x) = (x + 3)\, (-6x^2 + 5x + 4)$
$= (x + 3)\, (-6x^2 + 8x - 3x + 4)$
$= -(x + 3)\, (3x - 4)\, (2x + 1)$
$q(x) = (2x^2 + 7x + 3)\, (x + 3)$
$= (2x + 1)\, (x + 3)\, (x + 3)$
$\therefore$ L.C.M. $= -(x + 3)^2\, (3x - 4)\, (2x + 1)$.

**18.** **(c)** $p(x) = 36x^2 - 49$
$= (6x)^2 - (7)^2 = (6x + 7)\, (6x - 7)$
$q(x) = 6x^2 - 25x + 21$
$= 6x^2 - 18x - 7x + 21$
$= 6x(x - 3) - 7(x - 3)$
$= (6x - 7)\, (x - 3)$;
$\therefore$ G.C.D. $= (6x - 7)$.

**19.** **(b)** $30x^2 + 13x - 3 = 30x^2 + 18x - 5x - 3$
$= 6x(5x + 3) - 1(5x + 3)$
$= (5x + 3)\, (6x - 1)$
$q(x) = 25x^2 - 30x + 9$
$= 25x^2 - 15x - 15x + 9$
$= 5x(5x - 3) - 3(5x - 3) = (5x - 3)^2$
L.C.M. $= (5x - 3)^2\, (5x + 3)\, (6x - 1)$.

**20.** **(c)** $p(x) = 6x^2 + 11x + 3$
$= 6x^2 + 9x + 2x + 3$
$= 3x(2x + 3) + 1(2x + 3)$
$= (2x + 3)\, (3x + 1)$
$q(x) = 2x^2 + x - 3 = 2x^2 + 3x - 2x - 3$
$= (2x + 3)\, (x - 1)$
$\therefore$ G.C.D. $= (2x + 3)$.

**21.** **(c)** $\text{L.C.M} = \dfrac{\text{Product of expressions}}{\text{H.C.F.}}$

$$= \frac{pq}{1} = pq.$$

**22.** **(d)** $2x^2 - 4x = 2x(x - 2)$
$3x^4 - 12x^2 = 3x^2(x^2 - 4) = 3x^2(x - 2)\, (x + 2)$
$2x^5 - 2x^4 - 4x^3 = 2x^3(x^2 - x - 2)$
$= 2x^3(x - 2)\, (x + 1)$
$\therefore$ H.C.F. $= x(x - 2)$.

**23.** **(d)** $\text{L.C.M.} = \dfrac{\text{Product}}{\text{H.C.F.}} = \dfrac{(x + y + z)p^3}{p^2}$

$= (x + y + z)p$.

**24.** **(a)** Since $(x - 1)$ is the H.C.F., it will divide each one of the given expressions. So, $x = -1$ will make each one zero
$\therefore$ $p \times 1^2 - q(1 + 1) = 0$ or $p = 2q$.

**25.** **(b)** $x^2 - y^2 = (x - y)\, (x + y)$,
$x^3 - y^3 = (x - y)\, (x^2 + xy + y^2)$,
$x^3 - x^2y - xy^2 + y^3 = x^2(x - y) - y^2(x - y)$
$= (x - y)\, (x^2 - y^2)$
$= (x - y)^2\, (x + y)$
$\therefore$ L.C.M. $= (x - y)^2\, (x + y)\, (x^2 + y^2 + xy)$.

# Linear Equations

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## LINEAR EQUATION IN ONE VARIABLE

A linear equation in one variable is an equation of the type $ax + b = 0$ or, $ax = c$, where $a$, $b$, $c$ are constants (real numbers), $a \neq 0$ and $x$ is an unknown variable.

The solution of the linear equation $ax + b = 0$ is $x = -\frac{b}{a}$. We also say that $-\frac{b}{a}$ is the root of the linear equation $ax + b = 0$.

For example, the equation $2x + 3 = 0$ is a linear equation in one unknown variable $x$. Its solution or root is $-\frac{3}{2}$.

## LINEAR EQUATION IN TWO VARIABLES

A linear equation in two variables is an equation of the type $ax + by + c = 0$ or $ax + by = d$, where $a$, $b$, $c$ and $d$ are constants, $a \neq 0$, $b \neq 0$.

For example, $3x + 4y + 7 = 0$ and $2x - 3y = 5$ are linear equations in two variables $x$ and $y$.

**Methods of Solving Two Simultaneous Linear Equations**

**1. Method of Substitution**

**Step 1.** Find the value of one variable, say $y$, in terms of the other, i.e., $x$ from either equation.

**Step 2.** Substitute the value of $y$ so obtained in the other equation. Thus, we get an equation in only one variable $x$.

**Step 3.** Solve this equation for $x$.

**Step 4.** Substitute the value of $x$, thus obtained, in step 1 and find the value of $y$.

**Illustration 1:** Solve $2x + 3y = 7$, $3x - y = 5$.

**Solution:** The given equations are

$$x + y = 7 \quad \ldots(1)$$

and, $$3x - 2y = 11 \quad \ldots(2)$$

From Equation (1), we get $y = 7 - x$.

Substituting $y = 7 - x$ in Equation (2), we get

$3x - 2(7 - x) = 11 \Rightarrow 3x - 14 + 2x = 11$

$\Rightarrow 5x = 25 \Rightarrow x = 5.$

Substituting this value of $x$ in Equation (1), we get

$5 + y = 7 \Rightarrow y = 7 - 5$ or $y = 2$.

Hence, $x = 5$, $y = 2$ is the required solution.

**2. Method of Elimination**

**Step 1.** Multiply both the equations by such numbers so as to make the coefficients of one of the two unknowns numerically the same.

**Step 2.** Add or subtract the two questions to get an equation containing only one unknown. Solve this equation to get the value of the unknown.

**Step 3.** Substitute the value of the unknown in either of the two original equations. By solving that the value of the other unknown is obtained.

**Illustration 2:** Solve: $-6x + 5y = 2$, $-5x + 6y = 9$.

**Solution:** The given equations are

$$-6x + 5y = 2 \quad \ldots(1)$$

$$-5x + 6y = 9 \quad \ldots(2)$$

Multiplying Equation (1) by 6,

$$-36x + 30y = 12 \quad \ldots(3)$$

Multiplying Equation (2) by 5,

$$-25x + 30y = 45 \quad \ldots(4)$$

Subtracting Equation (4) from Equation (3), we get

$-11x = -33$ or $x = 3$.

Substituing $x = 3$ in Equation (1), we get

$-18 + 5y = 2$ or $y = 4$.

Hence, $x = 3$ and $y = 4$ is the required solution.

**3. Short-cut Method**

Let, the two equations be

$$a_1x + b_1y = c_1$$
$$a_2x + b_2y = c_2.$$

The solution is written as

$$\frac{x}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{-1}{a_1b_2 - a_2b_1}$$

i.e., $x = -\dfrac{b_1c_2 - b_2c_1}{a_1b_2 - a_2b_1}$, $y = -\dfrac{c_1a_2 - c_2a_1}{a_1b_2 - a_2b_1}$.

**Illustration 3:** Solve $3x + 2y = -25$, $-2x - y = 10$.

**Solution:** The two equations are

$$3x + 2y = -25$$
$$-2x - y = 10$$

The solution is given by

$$\frac{x}{2\times10-(-1)\times(-25)} = \frac{y}{(-25)\times(-2)-3\times10} = \frac{-1}{3\times(-1)-(-2)\times2}$$

or, $\dfrac{x}{-5} = \dfrac{y}{20} = \dfrac{-1}{1}$

or, $x = 5$, $y = -20$.

## Consistent and Inconsistent Equations

When a system of equations has a solution, the system is called consistent. And when a system of equations has no solution, the system is called inconsistent.

**Test for Consistency**

If we are given two linear equations

$a_1x + b_1y = c_1$ and $a_2x + b_2y = c_2$. Then,

(*a*) If $\dfrac{a_1}{a_2} \neq \dfrac{b_1}{b_2}$, the system will have exactly one solution and will be consistent.

***Note:***

The graphs of such equations will have intersecting lines.

(*b*) If $\dfrac{a_1}{a_2} = \dfrac{b_1}{b_2} = \dfrac{c_1}{c_2}$, the system is consistent and has infinitely many solutions.

***Note:***

The graphs of such equations will have coincident lines.

(*c*) If $\dfrac{a_1}{a_2} = \dfrac{b_1}{b_2} \neq \dfrac{c_1}{c_2}$, the system has no solution and is inconsistent.

***Note:***

The graphs of such equations will have parallel lines.

**Illustration 4:** For what values of $k$, will the system of equations $kx + 2y = 5$ and $3x + y = 1$ have a unique solution?

**Solution:** If the given system of equations has a unique solution,

$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \Rightarrow \frac{k}{3} \neq \frac{2}{1} \Rightarrow k \neq 6.$$

Hence, for $k \neq 6$, the given system of equations will have a unique solution.

**Illustration 5:** For what value of $k$, the system of equations $3x + 4y = 6$ and $6x + 8y = k$ represent, coincident lines?

**Solution:** If the given system of equations represents coincident lines

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2} \Rightarrow \frac{3}{6} = \frac{4}{8} = \frac{6}{k}$$

$$\Rightarrow k = \frac{6\times8}{4} = 12.$$

**Illustration 6:** For what value of $k$ the equations $9x + 4y = 9$ and $7x + ky = 5$ have no solution?

**Solution:** The given system of equations will have no solution

if, $\dfrac{a_1}{a_2} = \dfrac{b_1}{b_2} \neq \dfrac{c_1}{c_2} \Rightarrow \dfrac{9}{7} = \dfrac{4}{k} \neq \dfrac{9}{5}$

$\Rightarrow 9k = 28$ or $k = \dfrac{28}{9}$.

## EXERCISE-I

1. Solve: $x + y = 3$, $2x + 3y = 7$.
   (a) $x = 2, y = 1$ (b) $x = 1, y = 2$
   (c) $x = 3, y = 2$ (d) None of these
2. Solve: $x + y = 7$, $3x - 2y = 11$
   (a) $x = 7, y = 3$ (b) $x = 5, y = 2$
   (c) $x = 5, y = 3$ (d) None of these
3. Solve: $7x + 11y = 1$, $8x + 13y = 2$
   (a) $x = -5, y = 3$ (b) $x = -7, y = 2$
   (c) $x = -3, y = 2$ (d) None of these
4. Solve: $8u - 3v = 5uv$ $6u - 5v = -2uv$
   (a) $u = \frac{13}{23}, v = \frac{22}{33}$ (b) $u = \frac{11}{5}, v = \frac{13}{22}$
   (c) $u = \frac{11}{23}, v = \frac{22}{31}$ (d) None of these
5. Solve: $2(3u - v) = 5uv$, $2(u + 3v) = 5uv$
   (a) $u = 2, v = 1$ (b) $u = 3, v = 2$
   (c) $u = 4, v = 3$ (d) None of these
6. Solve: $ax + by = a - b$, $bx - ay = a + b$
   (a) $x = 2, y = -1$ (b) $x = -2, y = 1$
   (c) $x = 1, y = -1$ (d) None of these
7. Solve for $x$ and $y$: $\frac{2x}{a} + \frac{y}{b} = 2, \frac{x}{a} - \frac{y}{b} = 4.$
   (a) $x = 2a, y = -2b$ (b) $x = 3a, y = -3b$
   (c) $x = 3a, y = -2b$ (d) None of these
8. Given: $4x + \frac{6}{y} = 15$ and $6x - \frac{8}{y} = 14$. Find '$p$' if, $y = px - 2$.
   (a) $\frac{5}{3}$ (b) $\frac{7}{3}$
   (c) $\frac{4}{3}$ (d) None of these
9. Given: $\frac{2}{x} + \frac{2}{3y} = \frac{1}{6}$ and $\frac{3}{x} + \frac{2}{y} = 0$. Find '$a$' for which $y = ax - 4$.
   (a) 1 (b) 0
   (c) 2 (d) None of these
10. If $\frac{2}{x} + \frac{3}{y} = \frac{9}{xy}$ and $\frac{4}{x} + \frac{9}{y} = \frac{21}{xy}$, where $x \neq 0$, $y \neq 0$, the values of $x$ and $y$ are, respectively
    (a) 0 and 1 (b) 1 and 2
    (c) 2 and 3 (d) 1 and 3
11. The number of solutions of the equations $x + \frac{1}{y} = 2$ and $2xy - 3y = -2$ is:
    (a) 0 (b) 1
    (c) 2 (d) None of these
12. The equations $ax + b = 0$ and $cx + d = 0$ are consistent, if:
    (a) $ad = bc$ (b) $ad + bc = 0$
    (c) $ab - cd = 0$ (d) $ab + cd = 0$
13. The solution to the system of equations $|x + y| = 1$ and $x - y = 0$ is given by:
    (a) $x = y = \frac{1}{2}$ (b) $x = y = -\frac{1}{2}$
    (c) $x = 1, y = 0$ (d) $x = y = \frac{1}{2}$ or $x = y = \frac{-1}{2}$
14. In the system of the equations $\frac{1}{x} + \frac{1}{y} = \frac{5}{6}, \frac{1}{y} + \frac{1}{z} = \frac{7}{12}$ and $\frac{1}{z} + \frac{1}{x} = \frac{3}{4}$, values of $x$, $y$ and $z$ will be:
    (a) 4, 3 and 2 (b) 3, 2 and 4
    (c) 2, 3 and 4 (d) 3, 4 and 2
15. If $2x + y = 35$ and $3x + 4y = 65$, then find the value of $\frac{x}{y}$.
    (a) 2 (b) 1
    (c) 3 (d) None of these
16. I am three times as old as my son. 5 years later, I shall be two and a half times as old as my son. How old am I and how old is my son?
    (a) 45 years, 15 years (b) 40 years, 10 years
    (c) 60 years, 25 years (d) 50 years, 20 years
17. A man has some hens and cows. If the number of heads be 48 and number of feet equals 140, then the number of hens will be:
    (a) 26 (b) 24
    (c) 23 (d) 22
18. ₹49 were divided among 150 children. Each girl got 50 paise and a boy 25 paise. How many boys were there?
    (a) 100 (b) 102
    (c) 104 (d) 105

**19.** Find the condition for the following system of linear equations to have a unique solution:
$ax + by = c$, $lx + my = n$.

(a) $an \neq cl$ (b) $am \neq bl$
(c) $bm \neq al$ (d) None of these

**20.** Find the value of $k$ for which the system:
$kx + 2y = 5$, $3x + y = 1$ has a unique solution.
(a) $k = 6$ (b) $k \neq 9$
(c) $k \neq 6$ (d) None of these

**21.** Find the value of $c$ for which the system
$cx + 3y = c - 3$, $12x + cy = c$ has infinitely many solutions.
(a) 6 (b) 8
(c) 4 (d) None of these

**22.** Find the value of $k$ for which the system of equations $2x + 2y = 5$, $3x + ky = 7$ has no solution.

(a) 5 (b) 7
(c) 3 (d) 9

**23.** Find the value of $k$ for which the system of equations $2x + ky = 1$, $3x - y = 7$ has a unique solution.

(a) $k = -\frac{2}{3}$ (b) $k \neq \frac{2}{3}$

(c) $k \neq -\frac{2}{3}$ (d) $k = \frac{2}{3}$

## Exercise-2
## (Based on Memory)

**1.** An amount of money is to be divided among $P$, $Q$ and $R$ in the ratio of 3:5:7 respectively. If the amount received by $R$ is ₹4000 more than the amount received by $Q$, what will be the total amount received by $P$ and $Q$ together?

(a) ₹8000 (b) ₹12000
(c) ₹16000 (d) Cannot be determined

**[Allahabad Bank PO, 2010]**

**2.** The total marks obtained by a student in Physics, Chemistry and Mathematics together is 120 more than the marks obtained by him in Chemistry. What are the average marks obtained by him in Physics and Mathematics together?

(a) 60 (b) 120
(c) 40 (d) Cannot be determined

**[Allahabad Bank PO, 2010]**

**3.** Deepak has some hens and some goats. If the total number of aminal heads is 90 and the total number of animal feet is 248, what is the total number of goats Deepak has?

(a) 32 (b) 36
(c) 34 (d) Cannot be determined

**[Punjab National Bank PO, 2010]**

**4.** The sum of the 2 digits of a numbers is 15 and the difference between them is 3. What is the product of the 2 digits of the 2 digits number?

(a) 56 (b) 63
(c) 42 (d) None of these

**[Punjab National Bank PO, 2010]**

**5.** If $2x + 3y = 78$ and $3x + 2y = 72$, what is the value of $x + y$?

(a) 36 (b) 32
(c) 30 (d) Cannot be determined

**[Punjab National Bank PO, 2010]**

**6.** There are some parrots and some tigers in a forest. If the total number of animal heads in the forest are 858 and total number of animal legs are 1746, what is the number of parrots in the forest?

(a) 845 (b) 833
(c) 800 (d) None of these

**[Corporation Bank PO, 2010]**

**7.** There are 2 numbers such that the sum of twice the first number and thrice the second number is 100 and the sum of thrice the first number and twice the second number is 120. Which is the larger number?

(a) 32 (b) 12
(c) 14 (d) 35

**[Corporation Bank PO, 2010]**

**8.** The cost of 8 pens and $r$ pencils are ₹176 and the cost of 2 pens and 2 pencils is ₹48. What is the cost of 1 pen?

(a) ₹16 (b) ₹14
(c) ₹12 (d) None of these

**[Andhra Bank PO, 2009]**

**9.** Rubina could get equal number of ₹55, ₹85 and ₹105 tickets for a movie. She spents 2940 for all the tickets. How many of each did she buy?

(a) 12 (b) 14
(c) 16 (d) Cannot be determined

**[IBPS Bank PO, 2011]**

**10.** The difference between a 2 digit number and the number obtained by interchanging the 2 digits of the number is 9. If the sum of the 2 digits of the number is 15, then what is the original number?

(a) 89 (b) 67
(c) 87 (d) Cannot be determined

**[OBC PO, 2009]**

**11.** If $3Y + 9X = 54$ and $\frac{28X}{13Y} = \frac{140}{39}$, then what is the value of $Y - X$?

(a) −1 (b) −2
(c) 2 (d) 1

**[IOB PO, 2009]**

**12.** On a School's Annual Day sweets were to be equally distributed amongst 112 children. But on that particular day, 32 children were absent. Thus the remaining children got 6 extra sweets each. How many sweets was each child originally supposed to get?

(a) 24 (b) 18
(c) 15 (d) Cannot be determined

**[IOB PO, 2009]**

**13.** The difference between a 2-digit number and the number obtained by interchanging the 2 digits of the number is 9. What is the difference between the 2 digits of the number?

(a) 3 (b) 2
(c) 1 (d) Cannot be determined

**[NABARD Bank PO, 2009]**

**14.** Swapana spent ₹44620 on Deepawali Shooping, ₹32764 on buying Laptop and the remaining 32% of the total amount she had as cash with her. What was the total amount?

(a) ₹36416 (b) ₹113800
(c) ₹77384 (d) Cannot be determined

**[SBI PO, 2008]**

**15.** Rohit has some 50 paise coins, some ₹2 coins, some ₹1 coins and some ₹5 coins. The value of all coins is ₹50. Number of ₹2 coins is 5 more than the ₹5 coins. 50 paise coins are double in number than ₹1 coin. Value of 50 paise coins and ₹1 coins is ₹26. How many ₹2 coins does he have?

(a) 4 (b) 2
(c) 7 (d) Cannot be determined

**[Union Bank of India PO, 2011]**

**16.** The cost of 5 chairs and 3 tables is ₹3110. Cost of 1 chair is ₹210 less than the cost of 1 table. What is the cost of 2 tables and 2 chairs?

(a) ₹1660 (b) ₹1860
(c) ₹2600 (d) Cannot be determined

**[Bank of Baroda PO Examination, 2011]**

**17.** In a family of husband, wife and a daughter, the sum of the husband's age, twice the wife's age and thrice the daughters age is 85; while the sum of twice the husband's age, 4 times the wife's age and 6 times the daughter's age is 170. It is also given that the sum of 5 times the husband's age, ten times the wife's age and 15 times the daughter's age equals 450. The number of possible solutions, in terms of the ages of the husband, wife and the daughter, to this problem is:

(a) 0 (b) 1
(c) 2 (d) infinitely many

**18.** The number obtained by interchanging the 2 digits of a 2 digit number is lesser than the original number by 54. If the sum of the 2 digits of the number is 12, then what is the original number?

(a) 28 (b) 39
(c) 82 (d) None of these

**[IDBI PO, 2009]**

**19.** The sum of twice of a number and thrice of 42 is 238. What will be the sum of thrice of that number and twice of 42?

(a) 245 (b) 250
(c) 264 (d) 252

**[Syndicate Bank PO, 2010]**

**20.** A students was asked to divide a number by 6 and add 12 to the quotient. He, however, first added 12 to the number and then divided it by 6, gets 112 as the answer. The correct answer should have been:

(a) 124 (b) 122
(c) 118 (d) 114

**[SSC (GL), 2011]**

**21.** If $4x + 5y = 83$ and $3x : 2y = 21 : 22$, then $(y - x)$ equals:

(a) 3 (b) 4
(c) 7 (d) 11

**[SSC, 2014]**

**22.** The sum of 2 numbers is equal to 20 and their difference is 25. The ratio of the two numbers is:

(a) 9:1 (b) 7:9
(c) 3:5 (d) 2:7

**[SSC, 2014]**

**23.** The value of $k$ for which the graphs of $(k-1)x + y - 2 = 0$ and $(2-k)x - 3y + 1 = 0$ are parallel is:

(a) $\frac{1}{2}$ (b) $-\frac{1}{2}$
(c) 2 (d) –2

**[SSC, 2011]**

**24.** The graphs of $x + 2y = 3$ and $3x - 2y = 1$ meet the $y$-axis at two points having distance:

(a) $\frac{8}{3}$ units (b) $\frac{4}{3}$ units
(c) 1 units (d) 2 units

**[SSC, 2011]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (b) | **3.** (c) | **4.** (c) | **5.** (a) | **6.** (c) | **7.** (a) | **8.** (c) | **9.** (b) | **10.** (d) | **11.** (a) | **12.** (a) | **13.** (d) |
| **14.** (b) | **15.** (c) | **16.** (a) | **17.** (a) | **18.** (c) | **19.** (b) | **20.** (c) | **21.** (a) | **22.** (c) | **23.** (c) | | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (a) | **3.** (c) | **4.** (d) | **5.** (c) | **6.** (d) | **7.** (a) | **8.** (d) | **9.** (a) | **10.** (c) | **11.** (b) | **12.** (c) | **13.** (c) |
| **14.** (b) | **15.** (c) | **16.** (a) | **17.** (a) | **18.** (d) | **19.** (d) | **20.** (b) | **21.** (b) | **22.** (a) | **23.** (a) | **24.** (d) | | |

## EXPLANATORY ANSWERS

### Exercise-1

**1. (a)** $x + y = 3$ ...(1)

$2x + 3y = 7$ ...(2)

$y = 3 - x$ [From Equation (1)];

$\therefore\ 2x + 3(3 - x) = 7 \Rightarrow 2x + 9 - 3x = 7$

$\Rightarrow\ -x = -2$, i.e., $x = 2$

and, $y = 3 - 2 = 1$.

$\therefore\ x = 2$ and $y = 1$.

**2. (b)** $x + y = 7$ ...(1)

$3x - 2y = 11$ ...(2)

$y = 7 - x$ [From Equation (1)];

$\therefore\ 3x - 2(7 - x) = 11 \Rightarrow 3x - 14 + 2x = 11$

$\Rightarrow\ 5x = 25$, i.e., $x = 5$

$\therefore\ x = 5$ and, $y = 2$.

**3. (c)** $7x + 11y = 1$ ...(1)

$8x + 13y = 2$ ...(2)

Multiplying Equation (1) and Equation (2) by 8 and 7 respectively, we have

$56x + 88y = 8$ and $56x + 91y = 14$

Subtracting the second equation from the first, we get $-3y = -6$, i.e., $y = 2$

From Equation (1), $x = \frac{1-11(y)}{7} = \frac{1-11(2)}{7} = -3$

$\therefore\ x = -3$ and $y = 2$.

**4. (c)** $8u - 3v = 5uv$,

$6u - 5v = -2uv$

Dividing both equations by $uv$, we get

$\frac{8}{v} - \frac{3}{u} = 5$ and $\frac{6}{v} - \frac{5}{u} = -2$.

Putting $\frac{1}{v} = x$ and $\frac{1}{u} = y$, we get

$8x - 3y = 5$ ...(1)

and, $6x - 5y = -2$ ...(2)

Multiplying Equation (1) and Equation (2) by 6 and 8, respectively, we have,

$48x - 18y = 30$ and $48x - 40y = -16$

Subtracting the second equation from the first, we get

$22y = 46$, i.e., $y = -\dfrac{23}{11}$

From Equation (1), $x = \left(\dfrac{5+3y}{8}\right) = \dfrac{\left(5+3\left(\dfrac{23}{11}\right)\right)}{8} = \dfrac{31}{22}$

$\therefore \quad u = \dfrac{1}{y} = \dfrac{11}{23}$ and $v = \dfrac{1}{x} = \dfrac{22}{31}$.

**5. (a)** $2(3u - v) = 5uv \Rightarrow \dfrac{6}{v} - \dfrac{2}{u} = 5$

$2(u + 3v) = 5uv \Rightarrow \dfrac{2}{v} + \dfrac{6}{u} = 5$

Putting $\dfrac{1}{v} = x$ and $\dfrac{1}{u} = y$, we get

$6x - 2y = 5$ ...(1)

$2x + 6y = -2$ ...(2)

Multiplying Equation (1), and Equation (2) by 3 and 1 respectively, we have

$18x - 6y = 15$ and $2x + 6y = 5$

Adding these two equations, we get $20x = 20$, i.e., $x = 1$

From Equation (1), $y = \left(\dfrac{6x-5}{2}\right) = \left(\dfrac{6\times1-5}{2}\right) = \dfrac{1}{2}$

$\therefore \quad u = \dfrac{1}{y} = 2$ and $v = \dfrac{1}{x} = 1$

**6. (c)** $ax + by = a - b$ and $bx - ay = a + b$

Here, $\dfrac{a_1}{a_2} = \dfrac{a}{b}$ and $\dfrac{b_1}{b_2} = -\dfrac{b}{a} \Rightarrow \dfrac{a_1}{a_2} \neq \dfrac{b_1}{b_2}$

Therefore, a unique solution exists.

Writing the coefficients in the following array

$b \quad a - b \qquad a \quad b$

$-a \quad a + b \qquad b \quad -a$

we get, $\dfrac{x}{b(a+b)+a(a-b)} = \dfrac{y}{b(a-b)-a(a+b)}$

$= \dfrac{-1}{-a^2-b^2}$

$\Rightarrow \quad \dfrac{x}{b^2+a^2} = \dfrac{y}{-b^2-a^2} = \dfrac{1}{a^2+b^2}$

$\therefore \quad x = 1$ and $y = -1$.

**7. (a)** The given equations are

$2\dfrac{x}{a} + \dfrac{y}{b} = 2$ ...(1)

$\dfrac{x}{a} - \dfrac{y}{b} = 4$ ...(2)

Adding (1) and (2), we get

$3\dfrac{x}{a} = 6 \Rightarrow 3x = 6a \Rightarrow x = \dfrac{6a}{3} = 2a$

Putting $x = 2a$ in (1), we get

$2\dfrac{2a}{a} + \dfrac{y}{b} = 2 \Rightarrow 4 + \dfrac{y}{b} = 2$

$\Rightarrow \dfrac{y}{b} = 2 - 4 = -2$

$\Rightarrow y = -2b$

Hence, the required solution is $x = 2a$, $y = -2b$.

**8. (c)** We have, $4x + \dfrac{6}{y} = 15$ ...(1)

$6x - \dfrac{8}{y} = 14$ ...(2)

Multiplying equation (1) by 3 and equation (2) by 2, we get

$12x + \dfrac{18}{y} = 45$ ...(3)

$12x - \dfrac{16}{y} = 28$ ...(4)

Subtracting equation (4) from equation (3), we get

$\dfrac{34}{y} = 17 \Rightarrow y = \dfrac{34}{17} = 2$

Putting $y = 2$ in equation (1), we get

$4x + \dfrac{6}{2} = 15 \Rightarrow 4x + 3 = 15 \Rightarrow 4x = 15 - 3$

$\Rightarrow 4x = 12 \Rightarrow x = \dfrac{12}{14} = 3$

Hence, the solution is $x = 3$, $y = 2$. Now,

$y = px - 2 \Rightarrow 2 \Rightarrow p(3) - 2$

$\Rightarrow 3p = 4 \Rightarrow p = \dfrac{4}{3}$.

**9. (b)** We have, $\dfrac{2}{x} + \dfrac{2}{3y} = \dfrac{1}{6}$ ...(1)

$\dfrac{3}{x} + \dfrac{2}{y} = 0$ ...(2)

Putting $\dfrac{1}{x} = u$ and $\dfrac{1}{y} = u$, we get

$$2u + \frac{2}{3}v = \frac{1}{6} \qquad \ldots(3)$$

$3u + 2v = 0$ ...(4)

Multiplying equation (4) by $\frac{1}{3}$, we get

$$u + \frac{2}{3}v = 0 \qquad \ldots(5)$$

Subtracting equation (5) from equation (3), we get

$$u = \frac{1}{6}$$

Putting $u = \frac{1}{6}$ in (4), we get

$$3\left(\frac{1}{6}\right) + 2v - 0 \Rightarrow \frac{1}{2} + 2v - 0$$

$$\Rightarrow 2v = -\frac{1}{2} \Rightarrow v = -\frac{1}{4}$$

Now, $u = \frac{1}{6} \Rightarrow \frac{1}{x} = \frac{1}{6} \Rightarrow x = 6$

and, $v = -\frac{1}{4} \Rightarrow \frac{1}{y} = -\frac{1}{4} \Rightarrow y = -4$

Hence, the solution is $x = 6$, $y = -4$. Again,

$y = ax - 4 \Rightarrow -4 \Rightarrow a(6) - 4$

$\Rightarrow 6a = -4 + 4 \Rightarrow 6a = 0$

$$\Rightarrow a = \frac{0}{6} = 0.$$

**10.** **(d)** Multiplying each equation throughout by $xy$, we get

$3x + 2y = 9$ and, $9x + 4y = 21$

On solving these equations, we get

$x = 1$, $y = 3$.

**11.** **(a)** First equation gives $\frac{1}{y} = 2 - x$ or, $y = \frac{1}{2 - x}$

second equation is $y(2x - 3) = -2$

or, $\frac{2x - 3}{2} = -2 \quad \therefore \quad 2x - 3 = -2(2 - x)$

or, $2x - 3 = -4 + 2x$

This gives $1 = 0$

This is impossible. So, these is no solution at all.

**12.** **(a)** The equations are consistent if

$\frac{a}{c} = \frac{b}{d}$ i.e., if $ad = bc$.

**13.** **(d)** $|x + y| = 1$, Û $x + y = 1$

or, $-(x + y) = 1$ i.e., $x + y = -1$

Solving $x + y = 1$, $x - y = 0$, we get

$x = \frac{1}{2}$ and $y = \frac{1}{2}$

Solving $x + y = -1$ and $x - y = 0$, we get

$x = -\frac{1}{2}$ and $y = \frac{-1}{2}$

$$\therefore \quad x = y = \pm\frac{1}{2}.$$

**15.** **(c)** We have, $2x + y = 35$ ...(1)

$3x + 4y = 65$ ...(2)

From equation (1), $y = 35 - 2x$

Putting this value of y in (2), we get

$3x + 4(35 - 2x) = 65 \Rightarrow 3x + 140 - 8x = 65$

$\Rightarrow -5x = 65 - 140 = -75$

$$\Rightarrow x = \frac{-75}{-5} = 15$$

Substituting this value of $x$ in $y = 35 - 2x$, we get

$y = 35 - 2(15) = 35 - 30 = 5$

$$\therefore \frac{x}{y} = \frac{15}{5} = 3.$$

**16.** **(a)** Let, that I am $x$ years old and my son is $y$ years old. Then, according to the first condition of the problem,

$x = 3y$ ...(1)

Five years later, my age = $(x + 5)$ years and my son's age = $(y + 5)$ years.

Then, according to the second condition of the problem,

$$x + 5 = 2\frac{1}{2}(y + 5) \qquad \ldots(2)$$

Putting $x = 3y$ from (1), we get

$$3y + 5 = 2\frac{1}{2}(y + 5) \Rightarrow 3y + 5 = \frac{5}{2}(y + 5)$$

$\Rightarrow 6y + 10 = 5(y + 5)$

[Multiplying both sides by 2]

$\Rightarrow 6y + 10 = 5y + 25$

$\Rightarrow 6y - 5y = 25 - 10$

$\Rightarrow y = 15$

Putting $y = 15$ in (1) in (2), we get $x = 3(15) = 45$

Hence, I am 45 years old and my son is 15 years old, at present.

**17.** **(a)** Let, there be $x$ hens and $y$ cows

Then, $x + y = 48$ ...(1)

and, $2x + 4y = 140$ ...(2)

Solving (1) and (2), we get $x = 26$.

**18.** **(c)** Let, the number of boys be $x$ and the number of girls be $y$

Then, $x + y = 150$

$$\frac{25}{100}x + \frac{50}{100}y = 49$$

Solving $x + y = 150$ and $x + 2y = 196$, we get $x = 104$.

**19.** **(b)** we have, $ax + by = c$ ...(1)

$lx + my = n$ ...(2)

Here, $a_1 = a, b_1 = b, c_1 = c$

$a_2 = l, b_2 = m, c_2 = n.$

If the given system of linear equations has a unique solution,

$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \Rightarrow \frac{a}{l} \neq \frac{b}{m} \Rightarrow am \neq bl$$

**20.** **(c)** we have, $kx + 2y = 5$ ...(1)

$3x + y = 1$ ...(2)

Here, $a_1 = k, b_1 = 2, c_1 = 5$

$a_2 = 3, b_2 = 1, c_2 = 1$

The given system of equations will have a unique solution

if $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ i.e., if, $\frac{k}{3} \neq \frac{2}{1}$

i.e., if $\frac{k}{3} \neq 2$ i.e., if $k \neq 6$.

**21.** **(a)** For the equation, $cx + 3y = c - 3$ and $12x + cy = c$ to have an infinite number of solutions we must have,

$$\frac{c}{12} = \frac{3}{c} = \frac{(c-3)}{c} \Rightarrow \frac{c}{12} = \frac{3}{c} \text{ and } \frac{c}{12} = \frac{(c-3)}{c}$$

$\Rightarrow$ $c^2 = 36$ and $c^2 = 12c - 36$

$\Rightarrow$ $c = \pm 6$ and $(c - 6)^2 = 0$

$\Rightarrow$ $c = \pm 6$ and $c = 6$

$\Rightarrow$ $c = 6$.

**22.** **(c)** For no solution to exist. we need

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2} \Rightarrow \frac{2}{3} = \frac{2}{k}, \text{ i.e., } k = 3.$$

**23.** **(c)** For a unique solution to exist. we require

$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \Rightarrow \frac{2}{3} \neq \frac{k}{-1}, \text{ i.e., } k \neq -\frac{2}{3}.$$

## EXERCISE-2
## (BASED ON MEMORY)

**1.** **(c)** Let, $P$, $Q$ and $R$ got ₹$3x$, ₹$5x$ and ₹$7x$.

$7x - 5x = 4000$

$x = 2000$

$P + Q = 3x + 5x = 8x = ₹16000.$

**2.** **(a)** Let, marks got in physics, chemistry and mathematics are $P$, $C$ and $M$.

$P + C + M = C + 120$

$\therefore \quad P + M = 120$

$\frac{P+M}{2} = 60.$

**3.** **(c)** (H) Hens has one head and two feet.

(G) Goats has one head and four feet.

According to question,

H + G = 90 ...(1)

2H + 4G = 248 ...(2)

Multiplying by 2 in equation (1) and subtract

$$\begin{array}{r} 2H + 2G = 180 \\ 2H + 4G = 148 \\ - \quad - \quad \\ \hline -2G = -80 \therefore G = 34 \end{array}$$

$\therefore$ Number of goats = 34

Put the value of G in Equation (1),

H + 34 = 90

H = 56

**4.** **(d)** $x + y = 15$ ...(1)

$x - y = 3$ ...(2)

Add Equation (1) and (2),

$x = 9, y = 6$

Product of two digits of the number = 9 × 6 = 54

**5.** **(c)** $2x + 3y = 78$ ...(1)

$3x + 2y = 72$ ...(2)

Multiplying by 2 in Equation (1) and 3 in Equation (2) and subtract.

$$\begin{array}{r} 4x + 6y = 156 \\ 9x + 6y = 216 \\ - \quad - \quad - \\ \hline -5x = -60 \\ x = 12 \end{array}$$

Put the value of $x$ in Equation (1)

$2 \times 12 + 3y = 78$

$y = 18$

Then $x + y = 12 + 18 = 30$

**6.** **(d)** P + T = 858 ...(1)

(Because both have one head)

2P + 4T = 1746 ...(2)

(Because parrot has two legs and tiger has four legs) Multiply by 2 in Equation (1) and substract

$$\begin{array}{r} 2P+2T=1716 \\ -2P+4T=1746 \\ -\quad -\quad - \\ \hline -2T=-30 \end{array}$$

$\therefore$ T = 15

P = 843

**7.** **(a)** $2x + 3y = 100$ ...(1)

$3x + 2y = 120$ ...(2)

Multiply by 3 in Equation (1) and multiply by 2 in Equation (2) and then subtracted

$$\begin{array}{r} 6x+9y=300 \\ 6x+4y=240 \\ -\quad -\quad - \\ \hline 5y=60 \end{array}$$

$y = 12$

$x = 32$

**8.** **(d)** Let, the cost of one pen is ₹$x$ and the cost of one pencil is ₹$y$.

$8x + 4y = 176$ ...(1)

$2x + 2y = 48$ ...(2)

Multiplying by 2 in Equation (2),

$4x + 4y = 96$ ...(3)

Substracting Equation (3) and (1),

$$\begin{array}{r} 8x+4y=176 \\ 4x+4y=96 \\ -\quad -\quad - \\ \hline 4x=80 \\ x=20 \end{array}$$

So, the cost of one pen = ₹20

**9.** **(a)** Let, total tickets = $x$

Then, $55 \times x + 85 \times x + 105 \times x = 2940$

$\Rightarrow$ $245x = 2940$

$\Rightarrow$ $x = \dfrac{2940}{245}$

$\Rightarrow$ $x = 12$

**10.** **(c)** Let, the number is $10x + y$

(When number at unit place is $y$ and at tens place is $x$)

$(10x + y) - (10y + x) = 9$

$x - y = 1$ ...(1)

$x + y = 15$ ...(2)

Solving Equation (1) and (2) we get,

$x = 8$

$y = 7$

Required number = $10 \times 8 + 7 = 87$

**11.** **(b)** $3Y + 9X = 54$ ...(1)

$\dfrac{28X}{13Y} = \dfrac{140}{39}$

$1820Y - 1092X = 0$ ...(2)

From Equation (1) and (2),

$X = 5,\ Y = 3$

$\therefore$ $Y - X = 3 - 5 = -2$

**12.** **(c)** Let, each child got $x$ sweets.

$\therefore$ $112 \times x = (112 - 32) \times (x + 6)$

$112x = 80 \times (x + 6)$

$112x = 80x + 480$

$112x - 80x = 480$

$32x = 480$

$x = 15$

**13.** **(c)** Let, the number is $10x + y$.

$(10x + y) - (10y + x) = 9$

$\Rightarrow$ $9x - 9y = 9$

$\therefore$ Required difference $x - y = 1$

**14.** **(b)** Let, total amount was ₹$x$.

$\because$ $x - (44620 + 32764) = \dfrac{x \times 32}{100}$

$\Rightarrow$ $x - 77384 = 0.32\,x$

$\Rightarrow$ $x - 0.32x = 77384$

$\Rightarrow$ $0.68x = 77384$

$x = \dfrac{77384}{0.68}$

$= 113800$

**15.** **(c)** Let, 50 paise coins = $2x$ and ₹1 coins = $x$ both are ₹26 then the number of ₹1 coins will be 13 and number of 50 paise coins will be 26. Remaining amount = 50 − 26 = 24. Now if ₹5 coins are $x$ in number then ₹2 coins will be $x + 5$. Then, with the help of hit and trial method ₹5 coins will be in number and ₹2 coins will be $x + 5 = 2 + 5 = 7$ in number.

**16.** **(a)** Let, the cost of one Chair = C

and the cost of one Table = T

Then, 5C + 3T = 3110 ...(1)

and,

T − C = 210 or, T = 210 + C ...(2)

On putting value of T in Equation (1),

5C + 3(210 + C) = 3110

$\Rightarrow$ 5C + 630 + 3C = 3110

$\Rightarrow$ 8C = 3110 − 630

$\Rightarrow$ $C = \dfrac{2480}{8}$ = ₹310

$\therefore$ Cost of one Table (T) = 210 + 310

= 520

Hence, the cost of two Tables and two Chairs.

= 2T + 2C

= 2 × 520 + 2 × 310

= 1040 + 620

= ₹1660

**17.** **(a)** Let, the husband's age be $x$.
Let, the wife's age be $y$.
Let, the daughter's age be $z$.
According to questions,
$x + 2y + 3z = 85$ ...(1)
$2x + 4y + 6z = 170$ ...(2)
$5x + 10y + 15z = 450$ ...(3)
From Equation (2), $x + 2y + 3z = 85$
From Equation (3), $x + 2y + 3z = 90$
From Equation (1), $x + 2y + 3z = 85$
Hence, the above system of equation will give no solution.

**18.** **(d)** Let, required number = $10x + y$
Where $x > y$
According to question,
$(10x + y) - (10y + x) = 54$
$\Rightarrow 9x - 9y = 54$
$\Rightarrow 9(x - y) = 54$
$\Rightarrow x - y = 6$ ...(1)
and, $x + y = 12$ ...(2)
From Equation (1) and (2),
$x - y = 6$
$x + y = 12$
$\underline{2x = 18}$
$x = 9$
Value of $x = 9$, put in Equation (2)
$9 + y = 12$
$y = 12 - 9$
$y = 3$
$\therefore$ Number = $10 \times 9 + 3 = 90 + 3 = 93$

**19.** **(d)** According to the question, number = $x$
$x \times 2 + 42 \times 3 = 238$
$2x = 112$
$x = 56$
Again $3 \times 56 + 42 \times 2 = 168 + 84 = 252$

**20.** **(b)** Let, the number be $x$
Therefore, $\frac{x+12}{6} = 112$
$\Rightarrow x + 12 = 672$
$\Rightarrow x = 672 - 12 = 660$
Hence, correct answer
$= \frac{660}{6} + 12 = 110 + 12 = 122.$

**21.** **(b)** $\frac{3x}{2y} = \frac{21}{22}$
$\Rightarrow \frac{x}{y} = \frac{21}{22} \times \frac{2}{3} = \frac{7}{11} \Rightarrow \frac{x}{7} = \frac{y}{11} = k$
Now, according to the question,
$4x + 5y = 83$
$\Rightarrow 4 \times 7k + 5 \times 11k = 83$
$\Rightarrow 28k + 55k = 83$
$\Rightarrow 83k = 83 \Rightarrow k = 1$
$\Rightarrow x = 7$ and $y = 11$
$\therefore y - x = 11 - 7 = 4$

**22.** **(a)** Let, numbers be $x$ and $y$.
Now, according to the question,
$x + y = 25$ ...(1)
$x - y = 20$ ...(2)
On adding (1) and (2), we have,
$2x = 45$
$\Rightarrow x = \frac{45}{2} = 22.5$
From equation (1),
$22.5 + y = 25$
$\Rightarrow y = 25 - 22.5 = 2.5$
$\therefore$ Required ratio = 22.5:2.5 = 9:1

**23.** **(a)** The graphs of $(k-1)x + y - 2 = 0$ and $(2-k)x - 3y + 1 = 0$ are parallel.
$\therefore \frac{k-1}{2-k} = \frac{1}{-3} \Rightarrow -3k + 3 = 2 - k$
$\Rightarrow -3k + k = 2 - 3 \Rightarrow -2k = -1$
$\Rightarrow k = \frac{1}{2}$

***Note:***

Two straight lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ are parallel if,

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$$

**Alternative method:**
$(k-1)x + y - 2 = 0$
$\Rightarrow y = (1-k)x + 2$ ...(1)
and, $(2-k)x - 3y + 1 = 0$
$\Rightarrow 3y = (2-k)x + 1$
$\therefore y = \left(\frac{2-k}{3}\right)x + \frac{1}{3}$ ...(2)
$\because m_1 = m_2$
$\Rightarrow 1 - k = \frac{2-k}{3} \Rightarrow 3 - 3k = 2 - k$
$\therefore k = \frac{1}{2}$

**24.** **(d)** On $y$-axis, $x = 0$

Putting $x=0$ in $x+2y=3$,

$2y=3 \Rightarrow y=\frac{3}{2}$

Putting $x=0$ in $3x-2y=1$

$-2y=1 \Rightarrow y=-\frac{1}{2}$

$\therefore$ Points on $y$-axis are $\left(0,\frac{3}{2}\right)$ and $\left(0,-\frac{1}{2}\right)$.

$\therefore$ Required distance $=\sqrt{(0-0)^2+\left(\frac{3}{2}+\frac{1}{2}\right)^2}$

$=\sqrt{0+4}=2$ units

***Note:***

Distance $=\frac{3}{2}+\frac{1}{2}=2$

# Quadratic Equations

# 28

## INTRODUCTION

An equation of degree two is called a *quadratic equation*. The general form of a quadratic equation is $ax^2 + bx + c = 0$, where $a$, $b$, $c$ are real numbers, $a \neq 0$ and $x$ is a real variable. Some examples of quadratic equations are $x^2 + 4x + 3 = 0$, $3x^2 - 4x + 5 = 0$ and $3x^2 + 2x - 3 = 0$.

### Roots of a Quadratic Equation

A *root* of the equation $f(x) = 0$ is that value of $x$ which makes $f(x) = 0$. In other words, $x = a$ is said to be a root of $f(x) = 0$, where $f(a)$ is the value of the polynomial $f(x)$ at $x = a$ and is obtained by replacing $x$ by $a$ in $f(x)$.

For example, $-1$ is a root of the quadratic equation $x^2 + 6x + 5 = 0$ because $(-1)^2 + 6(-1) + 5 = 0$.

### Solution of a Quadratic Equation

If there is a quadratic equation $ax^2 + bx + c = 0$, $a \neq 0$, the roots of this equation are

$$\frac{-b+\sqrt{b^2-4ac}}{2a} \text{ and } \frac{-b-\sqrt{b^2-4ac}}{2a}.$$

**Illustration 1:** Solve the following quadratic equations:

(i) $6x^2 + x - 2 = 0$

(ii) $2x^2 + x - 1 = 0$

**Solution:** (i) Using formula:

$$\text{The roots are } x = \frac{-1\pm\sqrt{(1)^2-4(6)(-2)}}{2\times 6}$$

$$= \frac{-1\pm\sqrt{49}}{12} = \frac{6}{12}, \frac{-8}{12}.$$

i.e., $\frac{1}{2}, \frac{-2}{3}$.

Using factorization:

$$6x^2 + x - 2 = 0 \Leftrightarrow 6x^2 + 4x - 3x - 2 = 0$$

$$\Leftrightarrow 2x(3x + 2) - 1(3x + 2) = 0$$

$$\Leftrightarrow (2x + 1)(3x + 2) = 0$$

$$\Leftrightarrow x = \frac{1}{2} \text{ or } x = -\frac{2}{3}.$$

(ii) Using formula:

$$\text{The roots are } x = \frac{-1\pm\sqrt{(1)^2-4(2)(-1)}}{2\times 2}$$

$$= \frac{-1\pm\sqrt{9}}{4} = \frac{-1\pm 3}{4}$$

$$= \frac{2}{4}, \frac{-4}{4} \text{ i.e., } \frac{1}{2}, -1.$$

Using factorization:

$$2x^2 + x - 1 = 0 \Leftrightarrow 2x^2 + 2x - x - 1 = 0$$

$$\Leftrightarrow 2x(x + 1) - 1(x + 1) = 0$$

$$\Leftrightarrow (2x - 1)(x - 1) = 0.$$

$$\Leftrightarrow x = \frac{1}{2} \text{ or } x = -1.$$

### Nature of Roots

A quadratic equation has exactly two roots may be real or imaginary or coincident.

If $ax^2 + bx + c$, $a \neq 0$, then $D = b^2 - 4ac$ is called *discriminant*.

**1.** If $D > 0$, then there are two distinct and real roots given by

$$\alpha = \frac{-b+\sqrt{b^2-4ac}}{2a}, \beta = \frac{-b-\sqrt{b^2-4ac}}{2a}.$$

**2.** If $D = 0$, then there is a repeated real root given by

$\alpha = -\frac{b}{2a}$ i.e., roots are real and equal.

**3.** If $D < 0$, then there are no real roots.

***Note:***

The roots are rational if $D > 0$ and $D$ is a perfect square whereas the roots are irrational if $D > 0$ but $D$ is not a perfect square.

**Illustration 2:** Find the nature of the roots of the equations:

(i) $2x^2 + x - 1 = 0$

(ii) $x^2 + x + 1 = 0$

(iii) $x^2 + 5x + 5 = 0$

(iv) $\frac{4}{3}x^2 - 2x + \frac{3}{4} = 0$

**Solution:** (i) $D = (1)^2 - 4 \times 2 \times (-1) = 9 > 0$.

Also, $D$ is a perfect square.

So, the roots are real, distinct and rational.

(ii) $D = (1)^2 - 4 \times 1 \times 1 = -3 < 0$

So, the roots are imaginary.

(iii) $D = (5)^2 - 4 \times 1 \times 5 = 5 > 0$.

Also, $D$ is not a perfect square.

So, the roots are real, distinct and irrational.

(iv) $D = (-2)^2 - 4 \times \frac{4}{3} \times \frac{3}{4} = 0$.

So, the roots are real and equal.

**Illustration 3:** For what value of $k$ will the quadratic equation $kx^2 - 2\sqrt{5}\,x + 4 = 0$ have real and equal roots.

**Solution:** $D = (-2\sqrt{5})^2 - 4 \times k \times 4 = 20 - 16k$.

The given equation will have real and equal roots if $D = 0$.

i.e., $20 - 16k = 0$ or $k = \frac{20}{16} = \frac{5}{4}$.

***Note:***

1. If $p + \sqrt{q}$ is a root of a quadratic equation, then its other root is $p - \sqrt{q}$.

**Illustration 4:** If $2 + \sqrt{3}$ is one root of a quadratic equation, find the other root.

**Solution:** The other root is $2 - \sqrt{3}$.

2. $ax^2 + bx + c$ can be expressed as a product of two linear factors only when $D \geq 0$.

**Illustration 5:** For what value of $k$, the quadratic polynomial $kx^2 + 4x + 1$ can be factorized into two real linear factors.

**Solution:** $D = (4)^2 - 4 \times k \times 1 = 16 - 4k$.

The given quadratic polynomial can be factorized into real linear factors if $D \geq 0$.

i.e., $16 - 4k \geq 0$ or $-4k \geq -6$ or $k \leq 4$.

### Relation Between Roots and Coefficients

Let, $\alpha$, $\beta$ be the roots of the equation,

$$ax^2 + bx + c = 0$$

Then, sum of the roots

$$= \alpha + \beta = -\frac{b}{a} = -\frac{\text{coefficient of } x}{\text{coefficient of } x^2}$$

and product of the roots

$$= \alpha\beta = \frac{c}{a} = \frac{\text{constant term}}{\text{coefficient of } x^2}$$

**Illustration 6:** Find the sum and the product of the roots of the quadratic equation $2x^2 + 5\sqrt{3}\,x + 6 = 0$.

**Solution:** Here $a = 2$, $b = 5\sqrt{3}$, $c = 6$.

$\therefore$ Sum of the roots $= -\frac{b}{a} = -\frac{5\sqrt{3}}{2}$.

Product of the roots $= \frac{c}{a} = \frac{6}{2} = 3$.

### Formation of a Quadratic Equation with Given Roots

If $\alpha$, $\beta$ are the roots of a quadratic equation the equation can he written as

$$x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

i.e., $x^2$ – (sum of roots)$x$ + product of roots = 0.

**Illustration 7:** Find the quadratic equation whose roots are 5 and −6.

**Solution:** Sum of roots $= 5 + (-6) = -1$,

Product of roots $= 5 \times (-6) = -30$.

$\therefore$ The required quadratic equation is

$x^2 - (-1)x + (-30) = 0$ i.e., $x^2 + x - 30 = 0$.

## EXERCISE–I

**1.** In the following determine the set of value of $P$ for which the given quadratic equation has real roots.

$$Px^2 + 4x + 1 = 0$$

(a) $P \neq 4$ (b) $P > 4$
(c) $P \leq 4$ (d) $P \geq 4$

**2.** If one root of the quadratic equation $2x^2 + Px + 4 = 0$ is 2, find the second root and value of $P$.

(a) 1, −6 (b) 1, 6
(c) −1, 6 (d) −1, −6

**3.** One root of the quadratic equation $x^2 - 5x + 6 = 0$ is 3. Find the other root.

(a) 2 (b) −2
(c) 1 (d) −1

**4.** The roots of the equation

$\sqrt{7}x^2 - 6x - 13\sqrt{7} = 0$ are

(a) $-\sqrt{7}, \frac{-13\sqrt{7}}{7}$ (b) $\sqrt{7}, \frac{-13\sqrt{7}}{7}$

(c) $-\sqrt{7}, \frac{13\sqrt{7}}{7}$ (d) None of these

**5.** The roots of the equation

$3a^2x^2 - abx - 2b^2 = 0$ are

(a) $\frac{b}{a}, \frac{-2b}{3a}$ (b) $\frac{b}{a}, \frac{2b}{3a}$

(c) $\frac{-b}{a}, \frac{-2b}{3a}$ (d) None of these

**6.** The roots of the equation

$a^2x^2 - 3abx - 2b^2 = 0$ are

(a) $\frac{2b}{a}, \frac{-b}{a}$ (b) $\frac{2b}{a}, \frac{b}{a}$

(c) $\frac{-2b}{a}, \frac{b}{a}$ (d) None of these

**7.** Construct a quadratic equation whose roots are $\sqrt{2}$ and $2\sqrt{2}$

(a) $x^2 - 3\sqrt{2}x - 4 = 0$ (b) $x^2 - 3\sqrt{2}x + 4 = 0$

(c) $x^2 + 3\sqrt{2}x - 4 = 0$ (d) $x^2 + 3\sqrt{2}x + 4 = 0$

**8.** The roots of the equation

$ax^2 + (4a^2 - 3b)x - 12ab = 0$ are

(a) $4a, \frac{3b}{a}$ (b) $-4a, \frac{3b}{a}$

(c) $-4a, \frac{3b}{a}$ (d) $-4a, \frac{-3b}{a}$

**9.** Construct a quadratic equation whose roots have the sum = 6 and product = −16.

(a) $x^2 - 6x - 16 = 0$ (b) $x^2 + 6x - 16 = 0$

(c) $x^2 - \sqrt{3}x - 6 = 0$ (d) None of these

**10.** In the following, find the value ($s$) of $P$ so that the given equation has equal roots

$3x^2 - 5x + P = 0$

(a) −25/12 (b) 25/6
(c) 25/12 (d) − 25/6

**11.** If α and β are the roots of the equation $ax^2 + bx + c = 0$, find the value of $\alpha^2 + \beta^2$

(a) $\frac{b^2 - 2ac}{2a^2}$ (b) $\frac{b^2 + 2ac}{a^2}$

(c) $\frac{b^2 + 2ac}{2a^2}$ (d) $\frac{b^2 - 2ac}{a^2}$

**12.** If α and β are the roots of the quadratic equation $ax^2 + bx + c = 0$, the value of $\alpha^3 + \beta^3$ is

(a) $\frac{b(b^2 - 3ac)}{a^3}$ (b) $\frac{b(3ac - b^2)}{a^3}$

(c) $\frac{b(3ac + b^2)}{a^3}$ (d) None of these

**13.** If α and β are the roots of the quadratic equation $ax^2 + bx + c = 0$, then the value of $\frac{\alpha}{\beta} + \frac{\beta}{\alpha}$ is

(a) $\frac{b^2 - 2ac}{ac}$ (b) $\frac{b^2 - 2ac}{2ac}$

(c) $\frac{b^2 - ac}{2ac}$ (d) $\frac{b^2 + 2ac}{ac}$

**14.** The quadratic equation with rational coefficients, whose one root is $\sqrt{5}$, is:

(a) $x^2 + 5 = 0$ (b) $x^2 - 10 = 0$
(c) $x^2 - 5 = 0$ (d) None of these

**15.** The equation $x^2 - px + q = 0$, $p, q \in R$ has on real root if:

(a) $p^2 \le 4q$ (b) $p^2 < 4q$
(c) $p^2 > 4q$ (d) None of these

**16.** Determine $p$ so that the equation $x^2 + 5px + 16 = 0$ has on real root.

(a) $\frac{-4}{5} < p < \frac{4}{5}$ (b) $\frac{-8}{5} < p < \frac{8}{5}$

(c) $p < -\frac{4}{5}$ or $p > \frac{4}{5}$ (d) None of these

**17.** For what value of $k$ the quadratic polynomial $3z^2 + 5z + k$ can be factored into product of real linear factors?

(a) $k \le \frac{25}{6}$ (b) $k \le \frac{25}{12}$

(c) $k \ge \frac{25}{12}$ (d) $k \ge \frac{25}{6}$

**18.** $x = 3$ i a solution of the equation $3x^2 + (k - 1)x + 9 = 0$ if $k$ has value

(a) 13 (b) $-13$
(c) 11 (d) $-11$

**19.** One root of the equation $3x^2 - 10x + 3 = 0$ is $\frac{1}{36}$. Find the other root.

(a) 3 (b) 1/3
(c) $-3$ (d) None of these

**20.** The expression $x^4 + 7x^2 + 16$ can be factored as:

(a) $(x^2 + x + 1)(x^2 + x + 16)$

(b) $(x^2 + x + 1)(x^2 - x + 16)$

(c) $(x^2 + x + 4)(x^2 - x + 4)$

(d) $(x^2 + x - 4)(x^2 - x - 4)$

**21.** The common root of the equations $x^2 - 7x + 10 = 0$ and $x^2 - 10x + 16 = 0$ is:

(a) $-2$ (b) 3
(c) 5 (d) 2

**22.** The roots of the equation $x^2 + px + q = 0$ are equal if:

(a) $p^2 = 2q$ (b) $p^2 = 4q$
(c) $p^2 = -4q$ (d) $p^2 = -2q$

**23.** An equation equivalent to the quadratic equation $x^2 - 6x + 5 = 0$ is:

(a) $6x^2 - 5x + 1 = 0$ (b) $x^2 - 5x + 6 = 0$
(c) $5x^2 - 6x + 1 = 0$ (d) $|x - 3| = 2$

**24.** Divide 16 into 2 parts such the twice the square of the larger part exceeds the square of the smaller part by 164

(a) 10, 6 (b) 8, 8
(c) 12, 4 (d) None of these

**25.** With respect to the roots of $x^2 - x - 2 - 0$, we can say that:

(a) both of them are natural numbers
(b) both of them are integers
(c) the latter of the two is negative
(d) None of these

**26.** The solution of $2 - x = \frac{x-2}{x}$ would include:

(a) $-2, -1$ (b) $2, -1$
(c) $-4, 2$ (d) $4, -2$

**27.** If $\log_{10}(x^2 - 6x + 45) = 2$, then the values of $x$ are

(a) 6, 9 (b) 9, $-5$
(c) 10, 5 (d) 11, $-5$

**28.** If $\alpha, \beta$ are the roots of the equation $x^2 - 5x + 6 = 0$, construct a quadratic equation whose roots are $\frac{1}{\alpha}, \frac{1}{\beta}$.

(a) $6x^2 + 5x - 1 = 0$ (b) $6x^2 - 5x - 1 = 0$
(c) $6x^2 - 5x + 1 = 0$ (d) $6x^2 + 5x + 1 = 0$

**29.** The roots of $\frac{x+4}{x-4} + \frac{x-4}{x+4} = \frac{10}{3}$ are:

(a) $\pm 4$ (b) $\pm 6$
(c) $\pm 8$ (d) $2 \pm \sqrt{3}$

**30.** The roots of the equation $ax^2 + bx + c = 0$ will be reciprocal if

(a) $a = b$ (b) $b = c$
(c) $c = a$ (d) None of these

**31.** Form a quadratic equation whose one root is $3-\sqrt{5}$ and the sum of roots is 6

(a) $x^2 - 6x + 4 = 0$ (b) $x^2 + 6x + 4 = 0$
(c) $x^2 - 6x - 4 = 0$ (d) None of these

**32.** The value of $k$ for which the roots $\alpha$, $\beta$ of the equation: $x^2 - 6x + k = 0$ satisfy the relation $3\alpha + 2\beta = 20$, is

(a) 8 (b) −8
(c) 16 (d) −16

**33.** Find two consecutive positive odd integers whose squares have the sum 290.

(a) 11, 13 (b) 13, 15
(c) 9, 11 (d) None of these

**34.** Consider the equation $px^2 + qx + r = 0$, where $p$, $q$, $r$ are real. The roots are equal in magnitude but opposite in sign when:

(a) $q = 0, r = 0, p \neq 0$
(b) $p = 0, qr \neq 0$
(c) $r = 0, pr \neq 0$
(d) $q = 0, pr \neq 0$

**35.** Determine $k$ such that the quadratic equation $x^2 - 2(1+3k)x + 7(3+2k) = 0$ has equal roots.

(a) $2, \frac{-10}{9}$ (b) $2, \frac{10}{9}$

(c) $-2, \frac{10}{9}$ (d) $-2, \frac{-10}{9}$

**36.** If the equations $x^2 + 2x - 3 = 0$ and $x^2 + 3x - k = 0$ have a common root, then the non–zero value of $k$ is:

(a) 1 (b) 2
(c) 3 (d) 4

**37.** The roots of the equation $4x - 3.2^{x\,+\,2} + 32 = 0$ would include:

(a) 1, 2 and 3 (b) 1 and 2
(c) 1 and 3 (d) 2 and 3

**38.** The positive value of $m$ for which the roots of the equation $12x^2 + mx + 5 = 0$ are in the ratio 3:2 is:

(a) $5\sqrt{10}$ (b) $\frac{5}{2}\sqrt{10}$

(c) $\frac{5}{12}$ (d) $\frac{12}{5}$

**39.** If $\alpha$, $\beta$ are the roots of the equation $2x^2 - 3x + 1 = 0$, form an equation whose roots are $\frac{\alpha}{\beta}$ and $\frac{\beta}{\alpha}$

(a) $2x^2 + 5x + 2 = 0$ (b) $2x^2 - 5x - 2 = 0$
(c) $2x^2 - 5x + 2 = 0$ (d) None of these

**40.** Find the quadratic equation whose roots are reciprocal of the roots of the equation

$3x^2 - 20x + 17 = 0$

(a) $17x^2 - 20x + 3 = 0$
(b) $17x^2 + 20x + 3 = 0$
(c) $17x^2 - 20x - 3 = 0$
(d) None of these

**41.** If $\alpha$ and $\beta$ are the roots of the equation

$x^2 - 3\lambda x + \lambda^2 = 0$, find $\lambda$ if $\alpha^2 + \beta^2 = \frac{7}{4}$

(a) $\pm\frac{1}{2}$ (b) $\pm\frac{\sqrt{7}}{2}$

(c) $\pm\frac{\sqrt{3}}{2}$ (d) None of these

**42.** If $\alpha$, $\beta$ are the roots of the equation $ax^2 + bx + b = 0$, then

$\sqrt{\frac{\alpha}{\beta}} + \sqrt{\frac{\beta}{\alpha}} + \sqrt{\frac{b}{a}} =$

(a) 1 (b) 0
(c) 2 (d) 3

**43.** The expression $x^2 - x + 1$ has:

(a) one proper linear factor
(b) two proper linear factors
(c) no proper linear factor
(d) None of these

**44.** The length of a rectangular plot is 8 m greater than its breadth. If the area of the plot is 308 m$^2$, find the length of the plot.

(a) 22 m (b) 18 m
(c) 20 m (d) None of these

**45.** If $\alpha$, $\beta$ are the roots of the equation $x^2 + kx + 12 = 0$ such that $\alpha - \beta = 1$, the value of $k$ is

(a) 0 (b) $\pm 5$
(c) $\pm 1$ (d) $\pm 7$

**46.** The value of $x$ in the equation

$$\left(x+\frac{1}{x}\right)^2 - \frac{3}{2}\left(x-\frac{1}{x}\right) = 4 \text{ is:}$$

(a) $-2$ (b) $\frac{1}{2}$

(c) $-1$ (d) 0

**47.** If $\alpha$, $\beta$ are the roots of the quadratic equation $x^2 - 8x + k = 0$, find the value of $k$ such the $\alpha^2 + \beta^2 = 40$

(a) 12 (b) 14

(c) 10 (d) 16

**48.** Find the value of $k$ so that the sum of the roots of the equation $3x^2 + (2x + 1)x - k - 5 = 0$ is equal to the product of the roots:

(a) 4 (b) 6

(c) 2 (d) 8

## EXERCISE–2
## (BASED ON MEMORY)

**1.** The factors of $(a^2 + 4b^2 + 4b - 4ab - 2a - 8)$ are:

(a) $(a-2b-4)(a-2b+2)$

(b) $(a-b+2)(a+4b+4)$

(c) $(a+2b-4)(a+2b+2)$

(d) $(a+2b-1)(a-2b+1)$

**[SSC, 2014]**

**2.** Find the value of $\sqrt{30+\sqrt{30+\sqrt{30+\cdots}}}$.

(a) 5 (b) $3\sqrt{10}$

(c) 6 (d) 7

**[SSC, 2013]**

**3.** $\sqrt{6+\sqrt{6+\sqrt{6+\cdots}}}$ is equal to

(a) 2 (b) 5

(c) 4 (d) 3

**[SSC, 2011]**

**4.** The sum of the squares of two natural consecutive odd numbers is 394. The sum of the numbers is:

(a) 24 (b) 32

(c) 40 (d) 28

**[SSC, 2011]**

**Directions (Question. 5–9):** In this question two equations numbered I and II are given. You have to solve both the equations and find out the correct option.

**5. I.** $6x^2 + 41x + 63 = 0$

**II.** $4y^2 + 8y + 3 = 0$

(a) Relationship between $x$ and $y$ cannot be established

(b) $x \geq y$

(c) $x < y$

(d) $x > y$

(e) $x \leq y$

**[IBPS PO/MT, 2014]**

**6. I.** $x^2 + 10x + 24 = 0$

**II.** $4y^2 - 17y + 18 = 0$

(a) $x \leq y$

(b) $x \geq y$

(c) Relationship between $x$ and $y$ cannot be established

(d) $x > y$

(e) $x < y$

**[IBPS PO/MT, 2014]**

**7. I.** $24x^2 + 38x + 15 = 0$

**II.** $12y^2 + 28y + 15 = 0$

(a) $x \leq y$ (b) $x > y$

(c) $x \geq y$ (d) $x < y$

(e) $x = y$, or Relationship between $x$ and $y$ cannot be established

**[IBPS PO/MT, 2014]**

**8. I.** $3x^2 - 20x - 32 = 0$

**II.** $2y^2 - 3y - 20 = 0$

(a) $x < y$

(b) $x \leq y$

(c) $x > y$

(d) Relationship between $x$ and $y$ cannot be established

(e) $x \geq y$

**[IBPS PO/MT, 2014]**

**9. I.** $x^2 - 20x + 91 = 0$

**II.** $y^2 - 32y + 247 = 0$

(a) $x > y$
(b) Relationship between $x$ and $y$ cannot be established
(c) $x \geq y$
(d) $x \leq y$
(e) $x < y$

**[IBPS PO/MT, 2014]**

**Directions (Question. 10–14):** In each of these questions, two equations (I) and (II) are given. You have to solve both the equations and give answer

(a) If $x < y$ (b) If $x > y$
(c) If $x = y$ (d) If $x \geq y$
(e) If $x \leq y$ or no relationship can be established between $x$ and $y$.

**[IBPS PO/MT, 2013]**

**10. I.** $x^2 - 24x + 144 = 0$
**II.** $y^2 - 26y + 169 = 0$

**11. I.** $2x^2 + 3x - 20 = 0$
**II.** $2y^2 + 19y + 44 = 0$

**12. I.** $6x^2 + 77x + 121 = 0$
**II.** $y^2 + 9y - 22 = 0$

**13. I.** $x^2 - 6x = 7$
**II.** $2y^2 + 13y + 15 = 0$

**14. I.** $10x^2 - 7x + 1 = 0$
**II.** $35y^2 - 12y + 1 = 0$

**[IBPS PO/MT, 2013]**

**Directions (Question. 15–19):** In the following questions, two equations numbered I and II are given. You have to solve both questions and give answer

(a) if $x > y$
(b) if $x \geq y$
(c) if $x < y$
(d) if $x \leq y$
(e) if $x = y$ or the relationship cannot be established.

**15. I.** $x^2 - 19x + 84 = 0$
**II.** $y^2 - 25y + 156 = 0$

**[IOB PO, 2011]**

**16. I.** $x^3 - 468 = 1729$
**II.** $y^2 - 1733 + 1564 = 0$

**[IOB PO, 2011]**

**17. I.** $\frac{9}{\sqrt{x}} + \frac{19}{\sqrt{x}} = \sqrt{x}$

**II.** $y^5 - \frac{(2 \times 14)^{11/12}}{\sqrt{y}} = 0$

**[IOB PO, 2011]**

**18. I.** $\sqrt{784}x + 1234 = 1486$

**II.** $\sqrt{1089}y + 2081 = 2345$

**[IOB PO, 2011]**

**19. I.** $\frac{12}{\sqrt{x}} - \frac{23}{\sqrt{x}} = 5\sqrt{x}$

**II.** $\frac{\sqrt{y}}{12} - \frac{5\sqrt{y}}{12} = \frac{1}{\sqrt{y}}$

**[IOB PO, 2011]**

**Directions (Question. 20–24):** In each of these questions, two equations are given. You have to solve these equations and find out the values of $x$ and $y$ and

Give answer
(a) if $x < y$ (b) if $x > y$
(c) if $x \leq y$ (d) if $x \geq y$
(e) if $x = y$

**[Andhra Bank PO, 2011]**

**20. I.** $4x + 7y = 209$
**II.** $12x - 14y = -38$

**[Andhra Bank PO, 2011]**

**21. I.** $17x^2 + 48x = 9$
**II.** $13y^2 = 32y - 12$

**[Andhra Bank PO, 2011]**

**22. I.** $16x^2 + 20x + 6 = 0$
**II.** $10y^2 + 38y + 24 = 0$

**[Andhra Bank PO, 2011]**

**23. I.** $8x^2 + 6x = 5$
**II.** $12y^2 - 22y + 8 = 0$

**[Andhra Bank PO, 2011]**

**24. I.** $18x^2 + 18x + 4 = 0$
**II.** $12y^2 + 29y + 14 = 0$

**[Andhra Bank PO, 2011]**

**Directions (Question. 25–29):** In the following questions two equations numbered I and II are given. You have to solve both the equations and give answer

(a) $x > y$ (b) $x \geq y$
(c) $x < y$ (d) $x \leq y$
(e) $x = y$ or the relationship cannot be established

**[Corporation Bank PO, 2011]**

**25. I.** $x^2 - 11x + 24 = 0$
**II.** $2y^2 - 9y + 9 = 0$

**[Corporation Bank PO, 2011]**

**26.** **I.** $x^3 \times 13 = x^2 \times 247$

**II.** $y^{1/3} \times 14 = 294 \div y^{2/3}$

**[Corporation Bank PO, 2011]**

**27.** **I.** $\frac{12\times 4}{x^{4/7}} - \frac{3\times 4}{x^{4/7}} = x^{10/7}$

**II.** $y^3 + 783 = 999$

**[Corporation Bank PO, 2011]**

**28.** **I.** $\sqrt{500}x + \sqrt{402} = 0$

**II.** $\sqrt{360}y + (200)^{1/2} = 0$

**[Corporation Bank PO, 2011]**

**29.** **I.** $(17)^2 + 144 \div 18 = x$

**II.** $(26)^2 - 18\times 21 = y$

**[Corporation Bank PO, 2011]**

**Directions (Question. 30–34):** In each of these questions, two equations are given. You have to solve these equations and find out the values of $x$ and $y$ and give answer

(a) $x < y$ (b) $x > y$
(c) $x \le y$ (d) $x \ge y$
(e) $x = y$

**30.** **I.** $16x^2 + 20x + 6 = 0$

**II.** $10y^2 + 38y + 24 = 0$

**[Punjab and Sind Bank PO, 2011]**

**31.** **I.** $18x^2 + 18x + 4 = 0$

**II.** $12y^2 + 29y + 14 = 0$

**[Punjab and Sind Bank PO, 2011]**

**32.** **I.** $8x^2 + 6x = 5$

**II.** $12y^2 - 22y + 8 = 0$

**[Punjab and Sind Bank PO, 2011]**

**33.** **I.** $17x^2 + 48x = 9$

**II.** $13y^2 = 32y - 21$

**[Punjab and Sind Bank PO, 2011]**

**34.** **I.** $4x + 7y = 209$

**II.** $12x - 14y = -38$

**[Punjab and Sind Bank PO, 2011]**

**Directions (Question. 35–39):** In the following questions two equations numbered I and II are given. You have to solve both the equations and give answer

(a) if $x > y$ (b) if $x \ge y$
(c) if $x < y$ (d) if $x \le y$
(e) if $x = y$ or the relationship cannot be established.

**[Indian Bank PO, 2010]**

**35.** **I.** $x^2 - 4 = 0$

**II.** $y^2 + 6y + 9 = 0$

**[Indian Bank PO, 2010]**

**36.** **I.** $x^2 - 7x + 12 = 0$

**II.** $y^2 + y - 12 = 0$

**[Indian Bank PO, 2010]**

**37.** **I.** $x^2 = 729$

**II.** $y = \sqrt{729}$

**[Indian Bank PO, 2010]**

**38.** **I.** $x^4 - 227 = 398$

**II.** $y^2 + 321 = 346$

**[Indian Bank PO, 2010]**

**39.** **I.** $2x^2 + 11x + 14 = 0$

**II.** $4y^2 + 12y + 9 = 0$

**[Indian Bank PO, 2010]**

**Directions (Question. 40–44):** In the following questions two equations numbered I and II are given. You have to solve both the equations and give answer

(a) If $x > y$ (b) If $x \ge y$
(c) If $x < y$ (d) If $x \le y$
(e) If $x = y$ or the relationship cannot be established.

**40.** **I.** $x^2 - 1 = 0$

**II.** $y^2 + 4y + 3 = 0$

**[Corporation Bank PO, 2009]**

**41.** **I.** $x^2 - 7x + 12 = 0$

**II.** $y^2 - 12y + 32 = 0$

**[Corporation Bank PO, 2009]**

**42.** **I.** $x^3 - 371 = 629$

**II.** $y^3 - 543 = 788$

**[Corporation Bank PO, 2009]**

**43.** **I.** $5x + 2y = 31$

**II.** $3x + 7y = 36$

**[Corporation Bank PO, 2009]**

**44.** **I.** $2x^2 + 11x + 12 = 0$

**II.** $5y^2 + 27y + 10 = 0$

**[Corporation Bank PO, 2009]**

## ANSWER KEYS

### EXERCISE–1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (a) | **3.** (a) | **4.** (c) | **5.** (a) | **6.** (b) | **7.** (b) | **8.** (c) | **9.** (a) | **10.** (c) | **11.** (d) | **12.** (b) | **13.** (a) |
| **14.** (c) | **15.** (b) | **16.** (b) | **17.** (b) | **18.** (d) | **19.** (a) | **20.** (c) | **21.** (d) | **22.** (b) | **23.** (d) | **24.** (a) | **25.** (b) | **26.** (b) |
| **27.** (d) | **28.** (c) | **29.** (c) | **30.** (c) | **31.** (a) | **32.** (a) | **33.** (a) | **34.** (d) | **35.** (a) | **36.** (d) | **37.** (d) | **38.** (a) | **39.** (c) |
| **40.** (a) | **41.** (a) | **42.** (b) | **43.** (c) | **44.** (c) | **45.** (d) | **46.** (c) | **47.** (a) | **48.** (a) | | | | |

### EXERCISE–2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (c) | **3.** (d) | **4.** (d) | **5.** (c) | **6.** (e) | **7.** (c) | **8.** (d) | **9.** (d) | **10.** (a) | **11.** (d) | **12.** (e) | **13.** (d) |
| **14.** (d) | **15.** (d) | **16.** (b) | **17.** (e) | **18.** (a) | **19.** (a) | **20.** (e) | **21.** (a) | **22.** (b) | **23.** (c) | **24.** (d) | **25.** (b) | **26.** (c) |
| **27.** (d) | **28.** (c) | **29.** (c) | **30.** (b) | **31.** (d) | **32.** (c) | **33.** (a) | **34.** (e) | **35.** (a) | **36.** (b) | **37.** (d) | **38.** (e) | **39.** (c) |
| **40.** (b) | **41.** (d) | **42.** (c) | **43.** (a) | **44.** (e) | | | | | | | | |

## EXPLANATORY ANSWERS

### EXERCISE–1

**1. (c)** $Px^2 + 4x + 1 = 0$

Compare with $Ax^2 + Bx + C = 0$, we get

$$A = P,\ B = 4,\ C = 1$$

For real roots,

$B^2 - 4AC \geq 0 \Rightarrow 16 - 4P \geq 0$

$\Rightarrow 16 \geq 4P \Rightarrow P \leq 4.$

**2. (a)** The given equation is $2x^2 + Px + 4 = 0$

$\Rightarrow P(x) = 0$ where $P(x) = 2x^2 + Px + 4 = 0$

If 2 is a root of $P(x) = 0$, then $P(2) = 0$

$\Rightarrow 2(2)^2 + P(2) + 4 = 0 \Rightarrow 8 + 2P + 4 = 0$

$\Rightarrow 2P = -12 \Rightarrow P = \dfrac{-12}{2} = -6$

Hence the given equation is

$2x^2 - 6x + 4 = 0 \Rightarrow 2x^2 - 2x - 4x + 4 = 0$

$\Rightarrow 2x(x-1) - 4(x-1) = 0$

$\Rightarrow 2(x-2)(x-1) = 0$

$\Rightarrow x = 1$ or $x = 2$

Hence second root is 1.

**3. (a)** The given equation is

$$\begin{aligned} x^2 - 5x + 6 = 0 &\Rightarrow x^2 - 2x - 3x + 6 = 0 \\ &\Rightarrow x(x-2) - 3(x-2) = 0 \\ &\Rightarrow (x-2)(x-3) = 0 \\ &\Rightarrow x - 2 = 0 \text{ or } x - 3 = 0 \end{aligned}$$

Thus, the other root of the given quadratic equation is 2.

**4. (c)** $\sqrt{7}x^2 - 6x - 13\sqrt{7} = 0$

$\Rightarrow \sqrt{7}x^2 - 13x + 7x - 13\sqrt{7} = 0$

$\Rightarrow x(\sqrt{7}x - 13) + \sqrt{7}(\sqrt{7}x - 13) = 0$

$\Rightarrow (x + \sqrt{7})(\sqrt{7}x - 13) = 0$

$\Rightarrow x + \sqrt{7} = 0$ or $\sqrt{7}x - 13 = 0$

$\Rightarrow x = -\sqrt{7}$ or $x = \dfrac{13}{\sqrt{7}} = \dfrac{13\sqrt{7}}{7}$

Thus, the two roots of given quadratic equation are

$-\sqrt{7}$ and $\dfrac{13\sqrt{7}}{7}$.

**5.** **(a)** The given quadratic equation is

$$3a^2x^2 - abx - 2b^2 = 0 \Rightarrow 3a^2x^2 - 3abx + 2abx - 2b^2 = 0$$
$$\Rightarrow 3ax(ax-b) + 2b(ax-b) = 0$$
$$\Rightarrow (ax-b)(3ax+2b) = 0$$
$$\Rightarrow ax = b \text{ or } 3ax = -2b$$
$$\Rightarrow x = \frac{b}{a} \text{ or } x = -\frac{2b}{3a}.$$

**6.** **(b)** The given quadratic equation is

$$a^2x^2 - 3abx + 2b^2 = 0 \Rightarrow a^2x^2 - 2abx - abx + 2b^2 = 0$$
$$\Rightarrow ax(ax-2b) - b(ax-2b) = 0$$
$$\Rightarrow (ax-2b)(ax-b) = 0$$
$$\Rightarrow ax - 2b = 0 \text{ or } ax - b = 0$$
$$\Rightarrow x = \frac{2b}{a} \text{ or } x = \frac{b}{a}$$

Thus, the two roots of the given quadratic equation are $\frac{2b}{a}$ and $\frac{b}{a}$.

**7.** **(b)** Sum of the roots $= \sqrt{2} + 2\sqrt{2} = 3\sqrt{2}$

Product of the roots $= (\sqrt{2})(2\sqrt{2}) = 4$

Hence the required quadratic equation is $x^2$ = (sum of the roots) $x$ + (Product of two roots) = 0

$$\Rightarrow x^2 - 3\sqrt{2x} + 4 = 0.$$

**8.** **(c)** The given quadratic equation is

$$ax^2 + (4a^2 - 3b)x - 12ab = 0$$
$$\Rightarrow ax^2 + 4ax - 3bx - 12ab = 0$$
$$\Rightarrow ax(x+4a) - 3b(x+4a) = 0$$
$$\Rightarrow (ax-3b)(x+4a) = 0$$
$$\Rightarrow ax - 3b = 0 \text{ or } x + 4a = 0$$
$$\Rightarrow x = \frac{3b}{a} \text{ or } x = -4a$$

Thus, the two roots of the given quadratic equation are $-4a$ and $\frac{3b}{a}$.

**9.** **(a)** The required quadratic equation is $x^2$ – (sum of the roots) $x$ + (product of the roots) = 0

$$\Rightarrow x^2 - 6x - 16 = 0.$$

**10.** **(c)** The given quadratic equation is
$3x^2 - 5x + P = 0$
Comparing with $ax^2 + bx + c = 0$, we get
$a = 3,\ b = -5,\ c = P$
If the given quadratic equation has equal roots then its discriminant = 0

$$\Rightarrow b^2 - 4ac = 0 \Rightarrow (-5)^2 - 4(3)(P) = 0$$
$$\Rightarrow 25 - 12P = 0 \Rightarrow P = \frac{25}{12}$$

**11.** **(d)** Since $\alpha$ and $\beta$ are the roots of the quadratic equation $ax^2 + bx + c = 0$,

$$\therefore \alpha + \beta = -\frac{b}{a}, \alpha\beta = \frac{c}{a}$$
$$\alpha^2 + \beta^2 = (\alpha+\beta)^2 - 2\alpha\beta$$
$$= \left(-\frac{b}{a}\right)^2 - 2\frac{c}{a} = \frac{b^2}{a^2} - \frac{2c}{a} = \frac{b^2 - 2ac}{a^2}.$$

**12.** **(b)** Since $\alpha$, $\beta$ are the roots of the quadratic equation $ax^2 + bx + c = 0$

$$\therefore \alpha + \beta = -\frac{b}{a} \text{ and } \alpha\beta = \frac{a}{c}$$

Now, $\alpha^3 + \beta^3 = (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta)$

$$= \left(-\frac{b}{a}\right)^3 - 3\frac{c}{a}\left(\frac{-b}{a}\right)$$
$$= \frac{-b^3}{a} + \frac{3bc}{a^2} = \frac{-b^2 + 3abc}{a^3}$$
$$= \frac{b(3ac - b^2)}{a^3}$$

**13.** **(a)** Since $\alpha$ and $\beta$ are the roots of the equation $ax^2 + bx + c = 0$

$$\therefore \alpha + \beta = -\frac{b}{a}, \alpha\beta = \frac{c}{a}$$

Now, $\frac{\alpha}{\beta} + \frac{\beta}{\alpha} = \frac{\alpha^2 + \beta^2}{\alpha\beta} = \frac{(\alpha+\beta)^2 - 2\alpha\beta}{\alpha\beta}$

$$= \frac{\left(-\frac{b}{a}\right)^2 - 2\left(\frac{c}{a}\right)}{\frac{c}{a}} = \frac{\frac{b^2}{a^2} - \frac{2c}{a}}{\frac{c}{a}}$$
$$= \frac{\frac{b^2 - 2ac}{a^2}}{\frac{c}{a}} = \frac{b^2 - 2ac}{ac}.$$

**14.** **(c)** One root is $\sqrt{5}$

So the other root is $-\sqrt{5}$

$\therefore$ Sum of the roots is = 0

and product of the roots $= (\sqrt{5})(-\sqrt{5}) = -5$

$\therefore$ Required equation is $x^2$ – (sum of the roots)$x$ + (product of the roots) = 0

$$\Rightarrow x^2 - 5 = 0.$$

**15. (b)** The equation $x^2 - px + q = 0$; $p, q \in R$ has no real root if

$B^2 < 4AC$

$\Rightarrow (-p)^2 < 4.1.q \; [\because A = 1, B = -p, C = q]$

$\Rightarrow p^2 < 4q.$

**16. (b)** The given quadratic equation is $x^2 + 5px + 16 = 0 (1)$

Comparing it with $ax^2 + bx + c = 0$, we get $a = 1$, $b = 5p$, $c = 16$

If equation (1) has no real roots, then discriminant < 0

$\Rightarrow b^2 - 4ac < 0 \Rightarrow (5p)^2 - 4(1)(16) < 0$

$\Rightarrow 25p^2 - 64 < 0 \Rightarrow 25p^2 < 64$

$\Rightarrow p^2 < \frac{64}{25} \Rightarrow p^2 - \frac{64}{25} < 0$

$\Rightarrow \left(p - \frac{8}{5}\right)\left(p + \frac{8}{5}\right) < 0$

$\Rightarrow$ either $p - \frac{8}{5} > 0$ and $p + \frac{8}{5} < 0$

i.e., $p > \frac{8}{5}$ and $p < -\frac{8}{5}$,

which is not possible

or, $p - \frac{8}{5} < 0$ and $p + \frac{8}{5} > 0$

i.e., $p < \frac{8}{5}$ and $p > -\frac{8}{5}$ i.e., $-\frac{8}{5} < p < \frac{8}{5}$.

**17. (b)** We have $3z^2 + 5z + k$

Here $a = 3$, $b = 5$, $c = k$

$D = b^2 - 4ac = 25 - 12k$

For equal linear factors to exist, $D \geq 0$

i.e., $25 - 12k \geq 0 \quad \Rightarrow \quad 25 \geq 12k$

$\Rightarrow k \leq \frac{25}{12}$

Therefore, the set of real numbers $\leq \frac{25}{12}$ gives the set of value of $k$ for which the given quadratic polynomial can be factored into the product of real linear factors.

**18. (d)** Putting $x = 3$, we get

$27 + 3(k - 1) + 9 = 0$

or $27 + 3k - 3 + 9 = 0$

or $3k = -33$ or $k = -11$.

**19. (a)** The given quadratic equation is $3x^2 - 10x + 3 = 0$

Comparing with $ax^2 + bx + c = 0$, we get

$a = 3$, $b = -10$, $c = 3$

$\therefore$ Sum of the roots $= -\frac{b}{a} = \frac{10}{3}$

$\because$ One root $= \frac{1}{3}$

$\therefore$ The other root $= \frac{10}{3} - \frac{1}{3} = \frac{9}{3} = 3.$

**20 . (c)** $x^4 + 7x^2 + 16 = (x^4 + 8x^2 + 16) - x^2$

$= (x^2 + 4)^2 - x^2$

$= (x^2 + 4 + x)(x^2 + 4 - x)$

$= (x^2 + x + 4)(x^2 - x + 4).$

**21. (d)** $x^2 - 7x + 10 = 0 \Leftrightarrow (x - 5)(x - 2) = 0$

$\Leftrightarrow x = 5, 2$

$x^2 - 10x + 16 = 0 \Leftrightarrow (x - 8)(x - 2) = 0$

$\Leftrightarrow x = 8, 2$

$\therefore$ Common root is 2.

**22. (b)** Here $a = 1$, $b = p$, $c = q$

The roots of the equation $x^2 + px + q = 0$ are equal if

$b^2 - 4ac = 0 \Rightarrow p^2 - 4q = 0 \Rightarrow p^2 = 4q.$

**23. (d)** $x^2 - 6x + 5 = 0 \Leftrightarrow (x-5)(x-1) = 0$

$\Leftrightarrow x = 5$ or $1$

Also $|x - 3| = 2 \Leftrightarrow x - 3 = 2$ or $-(x-3) = 2 \Leftrightarrow x = 5$ or $x = 1$

$\therefore x^2 - 6x + 5 = 0$ and $|x - 3| = 2$ are equivalent.

**24. (a)** Let the smaller part be $x$. Then the larger part = $16 - x$. Now

$2(16-x)^2 - x^2 = 164 \Rightarrow 2(256 + x^2 - 32x) - x^2 = 164$

$\Rightarrow x^2 - 64x + 348 = 0$

$\Rightarrow x^2 - 6x - 58x + 348 = 0$

$\Rightarrow x(x-6) - 58(x-6) = 0$

$\Rightarrow (x-6)(x-58) = 0$

$x = 6$ or $x = 58$

But $m = 58$ is not possible, since sum of the two parts is 16

$\therefore \quad x = 6$, $\therefore$ other part = 10.

**25. (b)** The given equation is of the form

$ax^2 + bx + c = 0$

Also, $D = \sqrt{9} = 3$

So, roots are rational

Hence, both the roots must be integers.

**26. (b)** Given equation is

$2x - x^2 = x - 2 \Leftrightarrow x^2 - x - 2 = 0$

$\Leftrightarrow (x + 1)(x - 2) = 0$

$\Leftrightarrow x = 2$ or $= -1$.

**27.** **(d)** $\log_{10}(x^2 - 6x + 45) = 2$

$\Leftrightarrow x^2 - 6x + 45 = 10^2 = 100$

$\Leftrightarrow x^2 - 6x - 55 = 0$

$\Leftrightarrow (x - 11)(x + 5) = 0$

$\Leftrightarrow x = 11$ or $x = -5$.

**28.** **(c)** Comparing $x^2 - 5x + 6 = 0$ with

$ax^2 + bx + c = 0$

$a = 1, b = -5, c = 6$

$\therefore \quad \alpha + \beta = \frac{-b}{a} = \frac{5}{1} = 5$

$\alpha\beta = \frac{c}{a} = 6$

Now, we are to form an equation whose roots are $\frac{1}{\alpha}, \frac{1}{\beta}$.

So the required equation is

$x^2$ − (sum of roots)$x$ + (Product of roots) = 0

$x^2 - \left(\frac{1}{\alpha} + \frac{1}{\beta}\right)x + \left(\frac{1}{\alpha} \cdot \frac{1}{\beta}\right) = 0$

$x^2 - \left(\frac{\alpha + \beta}{\alpha\beta}\right)x + \left(\frac{1}{\alpha\beta}\right) = 0$

$x^2 - \frac{5}{6}x + \frac{1}{6} = 0$

$6x^2 - 5x + 1 = 0$.

**29.** **(c)** Given equation is: $y + \frac{1}{y} = \frac{10}{3}$,

where $y = \frac{x+4}{x-4}$

$\therefore \quad 3y^2 - 10y + 3 = 0 \Rightarrow y = 3, \frac{1}{3}$

$\therefore \quad y = \frac{x+4}{x-4} = 3$ or, $y = \frac{x+4}{x-4} = \frac{1}{3}$

$3x + 12 = x - 4$ or, $x + 4 = 3x - 12$

$\Rightarrow \quad x = -8$ or, $x = 8$

**30.** **(c)** For reciprocal roots, product of roots must be 1

$\therefore \quad \frac{c}{a} = 1$ i.e., $c = a$

**31.** **(a)** Sum of the roots = 6

One root $= 3 - \sqrt{5}$

$\therefore$ the other root $= 6 - (3 - \sqrt{5}) = 3 + \sqrt{5}$

$\therefore$ Product of roots $= (3 - \sqrt{5})(3 + \sqrt{5})$
$= 9 - 5 = 4$

Hence the required equation is

$x^2$ − (sum of the roots)$x$ + (product of roots) = 0

$\Rightarrow \quad x^2 - 6x + 4 = 0$.

**32.** **(a)** $\alpha + \beta = 6$ and $3\alpha + 2\beta = 20$

$\Rightarrow \quad \alpha = 4, \beta = 2$

Product of the roots $= k$

So, $k = \alpha\beta = 4 \times 2 = 8$.

**33.** **(a)** Let, the two consecutive odd positive integers be $2x + 1$ and $2x + 3$ where $x$ is a whole number.

Now,

$(2x + 1)^2 + (2x + 3)^2 = 290$

$\Rightarrow \quad 4x^2 + 4x + 1 + 4x^2 + 12x + 9 = 290$

$\Rightarrow \quad 8x^2 + 16x - 280 = 0$

$\Rightarrow \quad x^2 + 2x - 35 = 0$

$\Rightarrow \quad (x + 7)(x - 5) = 0 \Rightarrow x = 7, -5$

But, $x = -7$ is not possible, since $-7$ is not a whole number

$\therefore \quad x = 5$.

**34.** **(d)** Let, the roots be $\alpha$ and $-\alpha$. Then, sum of roots = 0

Also, roots being not equal, discriminant $\neq 0$

$\therefore \frac{q}{p} = 0$ and $q^2 - 4pr \neq 0$

$\Leftrightarrow q = 0$ and $pr \neq 0$.

**35.** **(a)** Comparing $x^2 - 2(1 + 3x)x + 7(3 + 2k) = 0$ with

$ax_2 + bx + c = 0$, we get

$a = 1, b = -2(1 + 3k), c = 7(3 + 2k)$

For equal roots $D = b^2 - 4ac = 0$

$\therefore 4(1 + 3k)^2 - 4 \times 1 \times 7(3 + 2k) = 0$

$\Rightarrow \quad 4(1 + k)^2 + 6k) - 84 - 56k = 0$

$\Rightarrow \quad 36k^2 - 32k - 80 = 0$

$\Rightarrow \quad 9k - 8k - 20 = 0$

$k = \frac{8 \pm \sqrt{64 - 4(9)(-20)}}{2 \times 9}$

$= \frac{8 \pm \sqrt{784}}{18} = \frac{8 \pm 28}{18}$

$= \frac{36}{18}, \frac{-20}{18} = 2, \frac{-10}{9}$.

**36.** **(d)** Let, $\alpha$ be a common root of the given equations.

Then, $\alpha^2 + 2\alpha - 3 = 0$ and $\alpha^2 + 3\alpha - k = 0$

$\therefore \quad \frac{\alpha^2}{-2k + 9} = \frac{\alpha}{-3 + k} = \frac{1}{3 - 2}$

So, $\alpha^2 = \frac{9 - 2k}{1}$ and $\alpha = \frac{k - 3}{1}$

So, $(9-2k)=(k-3)^2$ or $k^2-4k=0$

or, $k(k-4)=0$, so $k=4$.

**37.** **(d)** Given equation is: $2^{2x} - 3 \,.\, 2^x \times 2^2 + 32 = 0$

or, $2^{2x} - 12 \times 2^x + 32 = 0$

$\Rightarrow y^2-12y+32=0$, where $2^x = y$

$\Rightarrow (y-8)(y-4)=0 \Rightarrow y=8, y=4$

$\therefore\ 2^x=8$ or, $2^x=4$

$\Rightarrow 2^x=2^3$ or, $2^x=2^2$

$\Rightarrow x=3$ or, $x=2$.

**38.** **(a)** Let, the roots be 3α and 2α

Then, $3\alpha+2\alpha=\frac{m}{12} \Rightarrow \alpha=\frac{m}{60}$

$$\therefore\ \frac{5}{72}=\left(\frac{m}{60}\right)^2 \Leftrightarrow \frac{5}{72}=\frac{m^2}{3600}$$

$$\Leftrightarrow m^2=\frac{3600\times 5}{72}=250$$

$$\therefore\ m=\sqrt{250}=5\sqrt{10}.$$

**39.** **(c)** $\because$ $\alpha$, $\beta$ are the roots of the equation $2x^2 - 3x + 1 = 0$

$$\therefore\ \alpha+\beta=\frac{3}{2} \qquad \ldots(1)$$

and $\alpha\beta=\frac{1}{2}$ ...(2)

We are to form a quadratic equation whose roots are $\frac{\alpha}{\beta}$ and $\frac{\beta}{\alpha}$ $S$ = sum of the roots

$$=\frac{\alpha}{\beta}+\frac{\beta}{\alpha}=\frac{\alpha^2+\beta^2}{\alpha\beta}=\frac{(\alpha+\beta)^2-2\alpha\beta}{\alpha\beta}$$

$$=\frac{\left(\frac{3}{2}\right)^2-2\left(\frac{1}{2}\right)}{\frac{1}{2}} \qquad \text{[using (1) and (2)]}$$

$$=\frac{\frac{9}{4}-1}{\frac{1}{2}}=\frac{5}{4}\times\frac{2}{1}=\frac{5}{2}$$

$P$ = Product of the roots

$$=\frac{\alpha}{\beta}\times\frac{\beta}{\alpha}=1$$

Hence the required quadratic equation is $x^2$ – (sum of the roots)$x$ + (Product of the roots) = 0

$$\Rightarrow\ x^2-\frac{5}{2}x+1=0$$

$$\Rightarrow\ 2x^2-5x+2=0.$$

**40.** **(a)** The given quadratic equation is

$3x^2 - 20x + 17 = 0$ (1)

Compare with $ax^2 + bx + c = 0$, we get

$a = 3$, $b = -20$, $c = 17$

The roots of (1) are given by

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}=\frac{20\pm\sqrt{400-4(3)(17)}}{2\times 3}$$

$$=\frac{20\pm\sqrt{196}}{6}=\frac{20+14}{6},\frac{20-14}{6}$$

$$=\frac{34}{6},\frac{6}{6}=\frac{17}{3},1$$

Hence the roots of (1) are $\frac{17}{3}$ and 1. So we have to form an equation whose are $\frac{3}{17}$ and 1

Sum of the roots $=\frac{3}{17}+1=\frac{20}{17}$

Product of the roots $=\frac{3}{17}\times 1=\frac{3}{17}$

Hence, the required equation is

$$x^2-\frac{20}{17}x+\frac{3}{17}=0 \Rightarrow 17x^2-20x+3=0.$$

**41.** **(a)** $\because$ α, β are the roots of the equation $x2 - 3lx + l^2 = 0$

$$\alpha+\beta=3\lambda \qquad \ldots(1)$$

and $\alpha\beta=\lambda^2$ ...(2)

Now, $\alpha^2+\beta^2=\frac{7}{4}$ (given)

$$\Rightarrow\ (\alpha+\beta)^2-2\alpha\beta=\frac{7}{4}$$

$$\Rightarrow (3\lambda)^2-2\lambda^2=\frac{7}{4} \Rightarrow 7\lambda^2=\frac{7}{4}$$

$$\Rightarrow \lambda^2=\frac{1}{4} \Rightarrow \lambda=\pm\frac{1}{2}.$$

**42.** **(b)** $\because$ $\alpha$, $\beta$ are the roots of the equation

$$ax^2 + bx + b = 0$$

$$\therefore \alpha + \beta = -\frac{b}{a} \text{ and } \alpha\beta = \frac{b}{a}$$

Now, $\sqrt{\frac{\alpha}{\beta}} + \sqrt{\frac{\beta}{\alpha}} + \sqrt{\frac{b}{a}} = \frac{\alpha + \beta}{\sqrt{\alpha\beta}} + \sqrt{\frac{b}{a}}$

$$= \frac{-\frac{b}{a}}{\sqrt{\frac{b}{a}}} + \sqrt{\frac{b}{a}}$$

$$= -\sqrt{\frac{b}{a}} + \sqrt{\frac{b}{a}} = 0.$$

**43.** **(c)** Comparing $x^2 - x + 1$with $ax^2 + bx + c$ we have $a = 1$, $b = -1$, $c = 1$

Here $D = b^2 - 4ac = (-1)^2 - 4(1)\ (1)$

$= 1 - 4 = -3$

Since $D < 0$, so the given expression has no proper linear factor.

**44.** **(c)** Let, the breadth of the rectangular plot be $x$ $m$. Then the length of rectangular plot $= (x + 8)\ m$

$\therefore$ Area = Length × Breadth $= x(x + 8)m^2$ But the area of the plot is given to be 308 $m^2$

$$\therefore \quad x(x+8) = 308 \Rightarrow x^2 + 8x - 308 = 0$$

$$\Rightarrow x^2 + 22x - 14x - 308 = 0$$

$$\Rightarrow x(x+22) - 14(x-22) = 0$$

$$\Rightarrow (x+22)(x-14) = 0$$

$$\Rightarrow x = 14, -22$$

But, $x = -22$ is not possible, since breath cannot be negative

$\therefore \quad x = 14$

Hence the breadth of the rectangular plot = 14 m Length of the rectangular plot = (14 + 8) m = 22 m.

**45.** **(d)** Let, $\alpha$, $\beta$ be the roots of the equation $x^2 + kx + 12 = 0$

$$\therefore \quad \alpha + \beta = -k \text{ and } \alpha\beta = 12$$

Now $(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$

$$(1)^2 = k^2 - 4(12) \Rightarrow k^2 = 49 \Rightarrow k = \pm 7.$$

**46.** **(c)** Put $x - \frac{1}{x} = y$

$$\therefore \left(x + \frac{1}{x}\right)^2 = x^2 + \frac{1}{x^2} + 2 = \left(x + \frac{1}{x}\right)^2 + 4 = y^2 + 4$$

So, given equation becomes

$$\Rightarrow y\left(y - \frac{3}{2}\right) = 0 \Rightarrow y = 0 \text{ or } y = \frac{3}{2}$$

$$\therefore \quad x - \frac{1}{x} = 0 \text{ or } x - \frac{1}{x} = \frac{3}{2}$$

$$\Rightarrow x^2 - 1 = 0 \text{ or } 2x^2 - 3x - 2 = 0$$

$$\Rightarrow x = \pm 1 \quad \text{or } (2x+1)(x-2) = 0$$

or $x = -1/2$ or $x = 2$.

**47.** **(a)** $\because$ $\alpha$, $\beta$ are the roots of the equation $x^2 - 8x + 1 = 0$

$$\therefore \quad \alpha + \beta = \frac{-b}{a} = \frac{-(-8)}{1} = 8$$

and $\alpha\beta = \frac{c}{a} = \frac{k}{1} = k$

Now, $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$

$$\Rightarrow 40 = (8)^2 - 2k \Rightarrow 2k = 24 \Rightarrow k = 12.$$

**48.** **(a)** The given equation is $3x^2 + (2k + 1)x - k - 5 = 0$

Compare with $ax^2 + bx + c = 0$, we get

$$a = 3, b = 2k + 1, c = -k - 5$$

$\therefore$ Sum of the roots $= \frac{-b}{a} = \frac{-(2k+1)}{3}$

and Product of the roots $= \frac{c}{a} = \frac{-k-5}{3} = \frac{-(k+5)}{3}$

$\because$ Sum of the roots = Product of the roots

$$\therefore \frac{-(2k+1)}{3} = -\frac{(k+5)}{3} \Rightarrow 2k + 1 = k + 5$$

$$\Rightarrow 2k - k = 5 - 1$$

$$\Rightarrow k = 4.$$

## EXERCISE–2
## (BASED ON MEMORY)

**1.** **(a)** $a^2 + 4b^2 + 4b - 4ab - 2a - 8$

$= a^2 + 4b^2 - 4ab - 2a + 4b - 8$

$= (a - 2b)^2 - 2(a - 2b) - 8$

Let, $(a - 2b) = x$

$\therefore$ The given expression $= x^2 - 2x - 8$

$= x^2 - 4x + 2x - 8$

$= x(x - 4) + 2(x - 4)$

$= (x - 4)(x + 2)$

$= (a - 2b - 4)(a - 2b + 2)$

**2.** **(c)** $x = \sqrt{30 + \sqrt{30 + \sqrt{30 + \cdots}}}$

On squaring both sides, we have

$x^2 = 30 + \sqrt{30 + \sqrt{30 + \sqrt{30 + \cdots}}}$

$\Rightarrow x^2 = 30 + x \Leftrightarrow x^2 - x - 30 = 0$

$\Rightarrow x^2 - 6x + 5x - 30 = 0$

$\Rightarrow x(x - 6) + 5(x - 6) = 0$

$\Rightarrow (x - 6)(x + 5) = 0$

$\Rightarrow x = 6$ because $x \neq -5$

**3.** **(d)** Let, $x = \sqrt{6 + \sqrt{6 + \sqrt{6 + \cdots}}}$

On squaring both sides, we have

$x^2 = 6 + \sqrt{6 + \sqrt{6 + \sqrt{6 + \cdots}}}$

$\Rightarrow x^2 = 6 + x$

$\Rightarrow x^2 - x - 6 = 0$

$\Rightarrow x^2 - 3x + 2x - 6 = 0$

$\Rightarrow x(x - 3) + 2(x - 3) = 0$

$\Rightarrow (x + 2)(x - 3) = 0$

$\Rightarrow x = 3$ and $x \neq -2$ because numbers are positive.

**4.** **(d)** Let, the two natural consecutive odd numbers be $n$ and $(n + 2)$

Now, according to the question,

$\Rightarrow n^2 + (n + 2)^2 = 394$

$\Rightarrow n^2 + n^2 + 4 + 4n = 394$

$\Rightarrow 2n^2 + 4n - 390 = 0$

$\Rightarrow n^2 + 2n - 195 = 0$

$\Rightarrow n^2 + 15n - 13n - 195 = 0$

$\Rightarrow n(n + 15) - 13(n + 15) = 0$

$\Rightarrow (n - 13)(n + 15) = 0$

$\Rightarrow n = 13$ and $n \neq -15$

$\therefore$ numbers are 13 and 15.

$\therefore$ the sum of the numbers = 13 + 15 = 28

**Quicker Approach:**

By mental operation, $13^2 + 15^2 = 169 + 225 = 394$

$\therefore$ Required sum = 13 + 15 = 28

**5.** **(c)** **I.** $6x^2 + 41x + 63 = 0$

or, $6x^2 + 27x + 14x + 63 = 0$

or, $3x(2x + 9) + 7(2x + 9) = 0$

or, $(3x + 7)(2x + 9) = 0$

$\therefore \quad x = -\frac{3}{7}, \ -\frac{2}{9}$

**II.** $4y^2 + 8y + 3 = 0$

or, $4y^2 + 6y + 2y + 3 = 0$

or, $2y(2y + 3) + 1(2y + 3)$

or, $(2y + 1)(2y + 3)$

$\therefore \quad y = -\frac{1}{2}, \ -\frac{3}{2}$

Hence, $x < y$

**6.** **(e)** **I.** $x^2 + 10x + 24 = 0$

or, $x^2 + 6x + 4x + 24 = 0$

or, $x(x + 6) + 4(x + 6) = 0$

or, $(x + 4)(x + 6) = 0$

$\therefore \quad x = -4, -6$

**II.** $4y^2 - 17y + 18 = 0$

or, $4y^2 - 9y - 8y + 18 = 0$

or, $4y(y - 2) - 9(y - 2) = 0$

or, $(4y - 9)(y - 2) = 0$

$\therefore \quad y = \frac{9}{4}, 2$

Hence, $x < y$

**7.** **(c)** **I.** $24x^2 + 38x + 15 = 0$

or, $24x^2 + 20x + 18x + 15 = 0$

or, $4x(6x + 5) + 3(6x + 5) = 0$

or, $(4x + 3)(6x + 5) = 0$

$\therefore \quad x = -\frac{3}{4}, \ -\frac{5}{6}$

**II.** $12y^2 + 28y + 15 = 0$

or, $12y^2 + 18y + 10y + 15 = 0$

or, $6y(2y + 3) + 5(2y + 3) = 0$

or, $(6y + 5)(2y + 3) = 0$

$\therefore \quad y = -\frac{5}{6}, -\frac{3}{2}$

Hence, $x \geq y$

**8.** **(d)** **I.** $3x^2 - 20x - 32 = 0$

or, $3x^2 - 12x - 8x - 32 = 0$

or, $3x(x - 4) - 8(x - 4) = 0$

or, $(3x - 8)(x - 4) = 0$

**II.** $2y^2 - 3y - 20 = 0$

or, $2y^2 - 8y + 5y - 20 = 0$

or, $2y(y - 4) + 5(y - 4) = 0$

or, $(2y + 5)(y - 4) = 0$

$\therefore \quad y = 4, -\frac{5}{2}$

Hence no relationship can be established.

**9.** **(d)** **I.** $x^2 - 20x + 91 = 0$

or, $x^2 - 13x - 7x + 91 = 0$

or, $x(x - 13) - 7(x - 13) = 0$

or, $(x - 7)(x - 13) = 0$

$\Rightarrow \quad x = 13, 7$

**II.** $y^2 - 32y + 247 = 0$

or, $y^2 - 19y - 13y + 247 = 0$

or, $y(y - 19) - 13(y - 19) = 0$

or, $(y - 13)(y - 19) = 0$

$\Rightarrow \quad y = 13, 19$

Hence, $x \leq y$

**10.** **(a)** **I.** $x^2 - 24x + 144 = 0$

or, $x^2 - 12x - 12x + 144 = 0$

or, $x(x - 12) - 12(x - 12) = 0$

or, $(x - 12)^2 = 0$

$\therefore \quad x = 12$

**II.** $y^2 - 26y + 169 = 0$

or, $y^2 - 13y - 13y + 169 = 0$

or, $y(y - 13) - 13(y - 13) = 0$

or, $(y - 13)^2 = 0$

$\therefore \quad y = 13$

Hence, $x < y$

**11.** **(d)** **I.** $2x^2 + 3x - 20 = 0$

or, $2x^2 + 8x - 5x - 20 = 0$

or, $2x(x + 4) - 5(x + 4) = 0$

or, $(2x - 5)(x + 4) = 0$

or, $x = \frac{5}{2}, -4$

**II.** $2y^2 + 19y + 44 = 0$

or, $2y^2 + 11y + 8y + 44 = 0$

or, $2y(2y + 11) + 4(2y + 11) = 0$

or, $(y + 4)(2y + 11) = 0$

$\therefore \quad y = -4, -\frac{11}{2}$

Hence, $x \geq y$

**12.** **(e)** **I.** $6x^2 + 77x + 121 = 0$

or, $6x^2 + 66x + 11x + 121 = 0$

or, $6x(x + 11) + 11(x + 11) = 0$

or, $(6x + 11)(x + 11) = 0$

or, $x = -\frac{11}{6}, -11$

**II.** $y^2 + 9y - 22 = 0$

or, $y^2 + 11y - 2y - 22 = 0$

or, $y(y + 11) - 2(y + 11)$

or, $(y - 2)(y + 11) = 0$

or, $y = 2, -11$

Hence, no relationship can be established between $x$ and $y$.

**13.** **(b)** **I.** $x^2 - 6x = 7$

or, $x^2 - 6x - 7 = 0$

or, $x^2 - 7x + x - 7 = 0$

or, $x(x - 7) + 1(x - 7) = 0$

or, $(x + 1)(x - 7) = 0$

or, $x = -1, 7$

**II.** $2y^2 + 13y + 15 = 0$

or, $2y^2 + 10y + 3y + 15 = 0$

or, $2y(y + 5) + 3(y + 5) = 0$

or, $(2y + 3)(y + 5) = 0$

or $y = -\frac{3}{2}, -5$

Hence, $x > y$

**14.** **(d)** **I.** $10x^2 - 7x + 1 = 0$

or, $10x^2 - 5x - 2x + 1 = 0$

or, $5x(2x - 1) - 1(2x - 1) = 0$

or, $(5x - 1)(2x - 1) = 0$

or, $x = \frac{1}{5}, \frac{1}{2}$

**II.** $35y^2 - 12y + 1 = 0$

or, $35y^2 - 7y + 5y + 1 = 0$

or, $7y(5y - 1) - 1(5y - 1) = 0$

or, $(7y - 1)(5y - 1) = 0$

or, $y = \frac{1}{7}, \frac{1}{5}$

Hence, $x \geq y$

**15. (d) I.** $x^2 - 19x + 84 = 0$

$\Rightarrow x^2 - 7x - 12x + 84 = 0$

$\Rightarrow (x - 7)(x - 12) = 0$

$\Rightarrow x = 7, 12$

**II.** $y^2 - 25y + 156 = 0$

$\Rightarrow y^2 - 13y - 12y + 156 = 0$

$\Rightarrow (y - 13)(y - 12) = 0$

$\Rightarrow y = 12, 13$

$\therefore x \leq y$

**16. (b) I.** $x^3 - 468 = 1729$

$\Rightarrow x^3 = 2197$

$\Rightarrow x = 13$

**II.** $y^2 - 1733 + 1564$

$\Rightarrow y^2 = 169$

$\Rightarrow y = \pm 13$

$\therefore x \geq y$

**17. (e) I.** $\frac{9}{\sqrt{x}} + \frac{19}{\sqrt{x}} = \sqrt{x} \Rightarrow 9 + 19 = \sqrt{x} \times \sqrt{x} \Rightarrow x = 28$

**II.** $y^2 - \frac{(2 \times 14)^{11/2}}{\sqrt{y}} = 0 \Rightarrow y^5\sqrt{y} - (2 \times 14)^{11/2} = 0$

$\Rightarrow y^{11/2} = (2 \times 14)^{11/2}$

$\Rightarrow y = 2 \times 14 = 28$

$\therefore x = y$

**18. (a) I.** $\sqrt{784}x + 1234 = 1486$

$\Rightarrow \sqrt{784}x = 252$

$\Rightarrow 28x = 252$

$\Rightarrow x = 9$

**II.** $\sqrt{1089}y + 2081 = 2345$

$\Rightarrow 33y = 264$

$\Rightarrow y = 8$

$\therefore x > y$

**19. (a) I.** $\frac{12}{\sqrt{x}} - \frac{23}{\sqrt{x}} = 5\sqrt{x}$

$\Rightarrow 12 - 23 = 5\sqrt{x} \times \sqrt{x}$

$\therefore x = \frac{-11}{5} = -2.2$

**II.** $\frac{\sqrt{y}}{12} - \frac{5\sqrt{y}}{12} = \frac{1}{\sqrt{y}}$

$\Rightarrow \sqrt{y}\left(\frac{1}{12} - \frac{5}{12}\right) = \frac{1}{\sqrt{y}}$

$\Rightarrow y\left(\frac{-4}{12}\right) = 1$

$\Rightarrow y = \frac{-12}{4} = -3$

$\therefore x > y$

**20. (e)** $4x + 7y = 209$ …(1)

$12x - 14y = -38$ …(2)

**Multiplying (1) by (2):**

$8x + 14y = 418$ (3)

**Adding (2) and (3):**

$20x = 380 \Rightarrow x = 19$

**Substituting the value of x in (1), we get**

$76 + 7y = 209$

$\Rightarrow 7y = 133 \Rightarrow y = 19$

$\therefore x = y$

**21. (a) I.** $17x^2 + 48x - 9 = 0$

$\Rightarrow 17x^2 + 51x - 3x - 9 = 0$

$\Rightarrow 17x(x + 3) - 3(x + 3) = 0$

$\Rightarrow (17x - 3)(x + 3) = 0$

$\Rightarrow x = -3, \frac{3}{17}$

**II.** $13y^2 - 32y + 12 = 0$

$\Rightarrow 13y^2 - 26y - 6y + 12 = 0$

$\Rightarrow 13y(y - 2) - 6(y - 2) = 0$

$\Rightarrow (13y - 6)(y - 2) = 0$

$\Rightarrow y = 2, \frac{6}{13}$

$\therefore x < y$

**22. (b) I.** $16x^2 + 20x + 6 = 0$

$\Rightarrow 16x^2 + 12x + 8x + 6 = 0$

$\Rightarrow 4x(4x + 3) + 2(4x + 3) = 0$

$\Rightarrow (4x + 2)(4x + 3) = 0$

$\Rightarrow x = -\frac{3}{4}, -\frac{2}{4}$

**II.** $10y^2 + 38y + 24 = 0$

$\Rightarrow \quad 10y^2 + 30y + 8y + 24 = 0$

$\Rightarrow \quad 10y(y + 3) + 8(y + 3) = 0$

$\Rightarrow \quad (10y + 8)(y + 3) = 0$

$\Rightarrow \quad y = -3, \ -\frac{4}{5}$

$\therefore \quad x > y$

**23. (c) I.** $8x^2 + 6x - 5 = 0$

$\Rightarrow \quad 8x^2 + 10x - 4x - 5 = 0$

$\Rightarrow \quad 2x(4x + 5) - 1(4x + 5) = 0$

$\Rightarrow \quad (2x - 1)(4x + 5) = 0$

$\Rightarrow \quad x = \frac{1}{2}, \ -\frac{5}{4}$

**II.** $12y^2 - 22y + 8 = 0$

$\Rightarrow \quad 12y^2 - 16y - 6y + 8 = 0$

$\Rightarrow \quad 4y(3y - 4) - 2(3y - 4) = 0$

$\Rightarrow \quad (4y - 2)(3y - 4) = 0$

$\Rightarrow \quad y = \frac{1}{2}, \ \frac{4}{3}$

$\therefore \quad x \le y$

**24. (d) I.** $18x^2 + 18x + 4 = 0$

$\Rightarrow \quad 18x^2 + 12x + 6x + 4 = 0$

$\Rightarrow \quad 6x(3x + 2) + 2(3x + 2) = 0$

$\Rightarrow \quad (6x + 2)(3x + 2) = 0$

$\Rightarrow \quad x = -\frac{1}{3}, \ -\frac{2}{3}$

**II.** $12y^2 + 29y + 14 = 0$

$\Rightarrow \quad 12y^2 + 21y + 8y + 14 = 0$

$\Rightarrow \quad 3y(4y + 7) + 2(4y + 7) = 0$

$\Rightarrow (3y + 2)(4y + 7) = 6$

$\Rightarrow \quad y = -\frac{2}{3}, \ -\frac{7}{4}$

$\therefore \quad x \ge y$

**25. (b) I.** $x^2 - 11x + 24 = 0$

$\Rightarrow \quad x^2 - 8x - 3x + 24 = 0$

$\Rightarrow \quad x(x - 8) - 3(x - 8) = 0$

$\Rightarrow \quad (x - 3)(x - 8) = 0$

$\therefore \quad x = 3$ or, 8

**II.** $2y^2 - 9y + 9 = 0$

$\Rightarrow \quad 2y^2 - 3y - 6y + 9 = 0$

$\Rightarrow \quad y(2y - 3) - 3(2y - 3) = 0$

$\Rightarrow \quad (2y - 3)(y - 3) = 0$

$\therefore \quad y = \frac{3}{2}$ or, 3

$\therefore \quad x \ge y$

**26. (c) I.** $x^3 \times 13 = x^2 \times 247$

$\Rightarrow \quad \frac{x^3}{x^2} = \frac{247}{13}$

$\therefore \quad x = 19$

**II.** $y^{1/3} \times 14 = 249 \div y^{2/3}$

$\Rightarrow \quad y^{\frac{1}{3}} \times y^{\frac{2}{3}} = \frac{294}{14}$

$\Rightarrow \quad y^{\frac{1}{3}} \times y^{\frac{2}{3}} = 21$

$\therefore \quad y = 21$

Clearly, $x < y$

**27. (d)** $\frac{12 \times 4}{x^{\frac{4}{7}}} - \frac{3 \times 4}{x^{\frac{4}{7}}} = x^{\frac{10}{7}}$

$\Rightarrow \quad \frac{48}{x^{\frac{4}{7}}} - \frac{12}{x^{\frac{4}{7}}} = x^{\frac{10}{7}}$

$\Rightarrow \quad \frac{48 - 12}{x^{\frac{4}{7}}} = x^{\frac{10}{7}}$

$\Rightarrow \quad 36 = x^{\frac{10}{7} + \frac{4}{7}} \quad \Leftrightarrow \quad 36 = x^2$

$\therefore \quad x = \sqrt{36} = \pm 6$

**II.** $y^3 + 783 = 999$

$\Rightarrow \quad y^3 = 999 - 783 \quad \Leftrightarrow \quad y^3 = 216$

$\therefore \quad y = \sqrt[3]{216} \le 6$

Clearly, $x \le y$

**28. (c) I.** $\sqrt{500}x + \sqrt{402} = 0$

$\Rightarrow \quad \sqrt{500}x = -\sqrt{402}$

$\therefore \quad x = -\sqrt{\frac{402}{500}} = -\sqrt{\frac{400}{500}} = -0.9$

**II.** $\sqrt{360}y + (200)^{1/2} = 0$

$\Rightarrow \quad \sqrt{360}y = -\sqrt{200}$

$\therefore \quad y = -\sqrt{\frac{200}{360}} = -0.74$

Clearly, $x < y$

**29. (c) I.** $(17)^2 + 144 \div 18 = x$

$\Rightarrow \quad x = 17^2 + 144 \times \frac{1}{18}$

$\therefore \quad x = 289 + 8 = 297$

**II.** $(26)^2 - 18 \times 21 = y$

$\Rightarrow \quad y = 26^2 - 18 \times 21$

$\therefore \quad y = 676 - 378 = 298$

Clearly, $x < y$

**30.** **(b)** **I.** $16x^2 + 20x + 6 = 0$

$\Rightarrow \quad 8x^2 + 10x + 3 = 0$

$\Rightarrow \quad (4x + 3)(2x + 1) = 0$

$$\therefore \quad x = -\frac{3}{4} \text{ or, } -\frac{1}{2}$$

**II.** $10y^2 + 38y + 24 = 0$

$\Rightarrow \quad 5y^2 + 19y + 12 = 0$

$\therefore \quad (y + 3)(5y + 4) = 0$

$$\therefore \quad y = -3 \text{ or, } -\frac{4}{5}$$

Hence, $x > y$

**31.** **(d)** **I.** $18x^2 + 18x + 4 = 0$

$\Rightarrow \quad 9x^2 + 9x + 2 = 0$

$\Rightarrow \quad (3x + 2)(3x + 1) = 0$

$$\therefore \quad x = -\frac{2}{3} \text{ or, } -\frac{1}{3}$$

**II.** $12y^2 + 29y + 14 = 0$

$\Rightarrow \quad (3y + 2)(4y + 7) = 0$

$$\therefore \quad y = -\frac{2}{3} \text{ or, } -\frac{7}{4}$$

Hence, $x \geq y$

**32.** **(c)** **I.** $8x^2 + 6x - 5 = 0$

$\Rightarrow \quad (4x + 5)\,(2x - 1) = 0$

$$\therefore \quad x = -\frac{5}{4} \text{ or, } \frac{1}{2}$$

**II.** $12y^2 - 22y + 8 = 0$

$\Rightarrow \quad 6y^2 - 11y + 4 = 0$

$\Rightarrow \quad (2y - 1)\,(3y - 4) = 0$

$$\therefore \quad y = \frac{1}{2} \text{ or, } \frac{4}{3}$$

Hence, $x \leq y$

**33.** **(a)** **I.** $17x^2 + 48x - 9 = 0$

$\Rightarrow \quad (x + 3)(17x - 3) = 0$

$$\Rightarrow \quad x = -3 \text{ or, } \frac{3}{17}$$

**II.** $13y^2 - 32y + 12 = 0$

$\Rightarrow \quad (y - 2)(13y - 6) = 0$

$$\therefore \quad y = 2 \text{ or, } \frac{6}{13}$$

Hence, $x < y$

**34.** **(e)** **I.** $4x + 7y = 209$ ...(1)

**II.** $12x - 14y = -38$ ...(2)

Now, (1) × 2 + (2), we have

$12x - 14y = -38$

$8x + 14y = 418$

or, $\quad 20x = 380$

$$\therefore \quad x = \frac{380}{20} = 19$$

Now, putting the value of $x = 19$ in equation (1), We have,

$4 \times 19 + 7y = 209$

or, $\quad 7y = 209 - 76 = 133$

$$\therefore \quad y = \frac{133}{7} = 19$$

Hence, $x = y$

**35.** **(a)** $x = \pm 2$, $\quad y^2 + 6y + 9 = 0$

$$\begin{array}{cc} 3 & 3 \\ | & | \\ -3 & -3 \end{array}$$

**36.** (b) $\quad x^2 - 7x + 12 = 0 \quad y^2 + y - 12 = 0$

$$\begin{array}{cccc} -4 & -3 & 4 & -3 \\ | & | & | & | \\ 4 & 3 & -4 & 3 \end{array}$$

**37.** **(d)** **I.** $x = \pm\sqrt{729} = \pm 27$ $\quad$ **II.** $y = 27$

**38.** **(e)** **I.** $x^4 = 398 + 227 = 625$

$\Rightarrow \quad x = \pm 5$

**II.** $y^2 = (346 - 321) = 25$

$\Rightarrow \quad y = \pm 5$

**39.** **(c)** **I.** $\quad 2x^2 + 11x + 14 = 0$ $\quad$ **II.** $4y^2 + 12y + 9 = 0$

$$\begin{array}{cccc} 7 & 4 & 6 & 6 \\ | & | & | & | \\ \frac{7}{2} & \frac{4}{2} & \frac{6}{4} & \frac{6}{4} \\ | & | & | & | \\ \frac{-7}{2} & -2 & \frac{-3}{2} & \frac{-3}{2} \end{array}$$

**40.** **(b)** **I.** $x^2 - 1 = 0$

or, $\quad x^2 = 1$

or, $\quad x = \pm\sqrt{1} = \pm 1$

**II.** $y^2 + 4y + 3 = 0$

or, $y^2 + y + 3y + 3 = 0$

or, $y(y+1) + 3(y+1) = 0$

or, $(y+3)(y+1) = 0$

or, $y = -3$ or, $-1$

$\therefore\ x \geq y$

**41. (d) I.** $x^2 - 7x + 12 = 0$

or, $x^2 - 4x - 3x + 12 = 0$

or, $x(x-4) - 3(x-4) = 0$

or, $(x-3)(x-4) = 0$

or, $x = 3$ or, 4

**II.** $y^2 - 12y + 32 = 0$

or, $y^2 - 8y - 4y + 32 = 0$

or, $y(y-8) - 4(y-8) = 0$

or, $(y-4)(y-8) = 0$

or, $y = 4$ or, 8

$\therefore\ x \leq y$

**42. (c)** $x = \sqrt{1000} = 10,\ y = \sqrt{1331} = 11$

$\therefore\ x < y$

**43. (a)** Solving these two linear equations, we get $x = 5, y = 3$.

$\therefore\ x > y$

**44. (e) I.** $2x^2 + 11x + 12 = 0$

or, $2x^2 + 8x + 3x + 12 = 0$

or, $2x(x+4) + 3(x+4) = 0$

or, $(2x+3)(x+4) = 0$

$\therefore\ x = -\dfrac{3}{2}$ or, $-4$

**II.** $5y^2 + 27y + 10 = 0$

or, $5y^2 + 25y + 2y + 10 = 0$

or, $5(y+5) + 2(y+5) = 0$

or, $(5+2)(y+5) = 0$

$\therefore\ y = -\dfrac{2}{5}$ or, $-5$

# Progression

# 29

## INTRODUCTION

In this chapter, we shall be concerned with the study of sequences, i.e., special types of functions whose domain is the set $N$ of natural numbers. We shall study particular types of sequences called *arithmetic* sequences, *geometric* sequences and *harmonic* sequences and also their corresponding series.

Premiums on life insurance, fixed deposits in a bank, loan instalments payments, disintegration or decay of radioactive materials and the like are some of the examples where the concept of sequence and series is used.

## SEQUENCE

A *sequence* is a function whose domain is the set $N$ of natural numbers and range, a subset of real numbers or complex numbers.

A sequence whose range is a subset of real numbers is called a *real sequence*. Since we shall be dealing with real sequences only, we shall use the term 'sequence' to denote a 'real sequence'.

### Notation

The different terms of a sequence are usually denoted by $a_1, a_2, a_3, \ldots$ or by $t_1, t_2, t_3, \ldots$. The subscript (always a natural number) denotes the position of the term in the sequence. The number occurring at the $n$th place of a sequence, i.e., $t_n$ is called the *general term* of the sequence.

***Note:***

A sequence is said to be *finite* or *infinite* (according as finite or infinite number of terms it has.)

## PROGRESSIONS

If the terms of a sequence follow certain pattern, then the sequence is called a *progression*.

**Illustration 1:** Consider the following sequences:

(i) 3, 5, 7, 9, ..., 21.

(ii) 8, 5, 2, − 1, − 4, ...

(iii) 2, 6, 18, 54, ..., 1458.

(iv) $1, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \ldots$

(v) 1, 4, 9, 16, ...

We observe that each term (except the first) in (i) is formed by adding 2 to the preceding term; each term in (ii) is formed by subtracting 3 from the preceding term; each term in (iii) is formed by multiplying the preceding term by 3; each term in (iv) is formed by dividing the preceding term by 2; each term in (v) is formed by squaring the next natural number. Thus, each of (i) to (v) is a progression. Moreover, (i) and (iii) are finite sequences, whereas (ii), (iv) and (v) are infinite sequences.

However, to define a sequence we need not always have an explicit formula for the $n$th term. For example, for the infinite sequence 2, 3, 5, 7, 11, 13, 17, ... of all positive prime numbers, we may not be able to give an explicit formula for the $n$th term.

## SERIES

By adding or subtracting the terms of a sequence, we obtain a *series*. A series is finite or infinite according as the number of terms in the corresponding sequence is finite or infinite.

**Illustration 2:** The following are the series corresponding to the sequences, in illustration 1.

(i) 3 + 5 + 7 + 9 + ... + 21.

(ii) 8 + 5 + 2 + (− 1) + ...

(iii) 2 + 6 + 18 + 54 + ... + 1458.

(iv) $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \ldots$

(v) 1 + 4 + 9 + 16 + ...

## ARITHMETIC PROGRESSION (A.P.)

A sequence whose terms increase or decrease by a fixed number is called an *arithmetic progression*. The fixed number is called the *common difference* of the A.P.

In an A.P., we usually denote the first term by $a$, the common difference by $d$ and the $n$th term by $t_n$. Clearly, $d = t_n - t_{n-1}$. Thus, an A.P. can be written as

$$a, a + d, a + 2d, ..., a + (n - 1) d, ...$$

**Illustration 3:** Consider the series: 1, 3, 5, 7, 9, ...

Here, 2nd term − 1st term = 3rd term − 2nd term = 4th term − 3rd term = ... = 2.

Hence 1, 3, 5, 7, ... are in A.P. whose first term is 1 and common difference is 2.

**Illustration 4:** The series: 5, 3, 1, −1, −3, −5, −7, ... is in A.P. whose first term is 5 and common difference is −2.

***Notes:***

- A sequence $t_1, t_2, t_3, t_4, ...$ will be in A.P. if $t_2 - t_1 = t_3 - t_2 = t_4 - t_3 = ...$, i.e., $t_n - t_{n-1}$ = constant, for $n \geq 2$.
- Three numbers $a$, $b$, $c$ are in A.P. if and only if $b - a = c - b$, i.e., if and only if $a + c = 2b$.
- Any three numbers in an A.P. can be taken as $a - d$, $a$, $a + d$. Any four numbers in an A.P. can be taken as $a - 3d$, $a - d$, $a + d$ and $a + 3d$.
  Similarly, five numbers in an A.P. can be taken as $a - 2d$, $a - d$, $a$, $a + d$ and $a + 2d$.

### GENERAL TERM OF AN A.P.

Let $a$ be the first term and $d$ be the common difference of an A.P. Then, the A.P. is $a$, $a + d$, $a + 2d$, $a + 3d$,... . We also observe that,

$t_1$, the first term, is $a = a + (1 - 1) d$;
$t_2$, the second term, is $a + d = a + (2 - 1) d$;
$t_3$, the third term, is $a + 2d = a + (3 - 1) d$;
$t_4$, the fourth term, is $a + 3d = a + (4 - 1) d$;
$t_n$, the $n$th term, is $a + (n - 1) d$.

Thus, the formula, $t_n = a + (n - 1) d$ gives the general term of an A.P.

***Notes:***

- If an A.P. has $n$ terms, then the $n$th term is called the *last term* of A.P. and it is denoted by $l$. Therefore, $l = a + (n - 1) d$.
- If $a$ is the first term and $d$ the common difference of an A.P. having $m$ terms, then $n$th term from the end is $(m - n + 1)$th term from the beginning.
  $\therefore$ $n$th term from the end $= a + (m - n) d$.

**Illustration 5:** A sequence $< t_n >$ is given by the formula $t_n = 10 - 3n$. Prove that it is an A.P.

**Solution:** We have,

$$t_n = 10 - 3n \Rightarrow t_{n+1} = 10 - 3(n + 1) = 7 - 3n.$$

$$\therefore \quad t_{n+1} - t_n = (7 - 3n) - (10 - 3n) = -3,$$

Which is independent of $n$ and hence a constant.

Therefore, the given sequence $< t_n >$ is an A.P.

**Illustration 6:** Find the $n$th term and 19th term of the sequence 5, 2, − 1, − 4, ....

**Solution:** Clearly, the given sequence is an A.P. with $a = 5$ and $d = -3$.

$$\therefore \quad t_n = a + (n - 1) d = 5 + (n - 1) (-3) = -3n + 8.$$

For the 19th term, putting $n = 19$, we get $t_{19} = -3.19 + 8 = -49$.

Sum of $n$ terms of an A.P.

The sum of $n$ terms of an A.P. with first term '$a$' and common difference '$d$' is given by

$$S_n = \frac{n}{2}[2a + (n - 1)d]$$

***Note:***

- If $S_n$ is the sum of $n$ terms of an A.P. whose first term is '$a$' and last term is $l$, then
  $$S_n = \frac{n}{2}(a + l).$$
- If common difference $d$, number of terms $n$ and the last term $l$, are given then
  $$S_n = \frac{n}{2}[2l - (n - 1) d]$$
- $t_n = S_n - S_{n-1}$.

**Illustration 7:** Find the sum of the series

$$.5 + .51 + .52 + ... \text{ to } 100 \text{ terms.}$$

**Solution:** The given series is an A.P. with first term, $a = .5$ and common difference, $d = .51 - .5 = .01$.

$\therefore$ Sum of 100 terms

$$= \frac{100}{2}[2 \times \cdot 5 + (100 - 1) \times .01]$$
$$= 50 (1 + 99 \times .01) = 50 (1 + .99)$$
$$= 50 \times 1.99 = 99.5.$$

**Illustration 8:** Find the sum of 20 terms of an A.P., whose first term is 3 and the last term is 57.

**Solution:** We have, $a = 3$, $l = 57$, $n = 20$.

$$\therefore \quad S_n = \frac{n}{2}(a + l), \quad \therefore \quad S_{20} = \frac{20}{2}(3 + 57) = 600.$$

Hence, the sum of 20 terms is 600.

## GEOMETRIC PROGRESSION

A sequence (finite or infinite) of non-zero numbers in which every term, except the first one, bears a constant ratio with its preceding term, is called a *geometric* progression, abbreviated as G.P.

**Illustration 9:** The sequences given below:

(i) 2, 4, 8, 16, 32, ...

(ii) 3, –6, 12, –24, 48, ...

(iii) $\frac{1}{4}, \frac{1}{12}, \frac{1}{36}, \frac{1}{108}, \frac{1}{324}, \ldots$

(iv) $\frac{1}{5}, \frac{1}{30}, \frac{1}{180}, \frac{1}{1080}, \frac{1}{6480}, \ldots$

(v) $x, x^2, x^3, x^4, x^5, \ldots$ (where $x$ is any fixed real number),

are all geometric progressions. The ratio of any term in (i) to the preceding term is 2. The corresponding ratios in (ii), (iii), (iv) and (v) are $-2, \frac{1}{3}, \frac{1}{6}$, and $x$ respectively. The ratio of any term of a G.P. to the preceding term is called the *common ratio* of the G.P. Thus, in the above examples, the common ratios are $2, -2, \frac{1}{3}, \frac{1}{6}$ and $x$ respectively.

**Note:**

In a G.P., any term may be obtained by multiplying the preceding term by the common ratio of the G.P. Therefore, if any one term and the common ratio of a G.P. be known, any term can be written out, i.e., the G.P. is then completely known.

In particular, if the first term and the common ratio are known, the G.P. is completely known. The first term and the common ratio of a G.P. are generally denoted by $a$ and $r$, respectively.

### GENERAL TERM OF A G.P.

Let, $a$ be the first term and $r$ ($\neq 0$) be the common ratio of a G.P. Let $t_1, t_2, t_3, \ldots, t_n$ denote Ist, 2nd, 3rd, ... , $n$th terms, respectively. Then, we have

$$t_2 = t_1 r,\ t_3 = t_2 r,\ t_4 = t_3 r,\ \ldots,\ t_n = t_{n-1} r.$$

On multiplying these, we get

$t_2 t_3 t_4 \ldots t_n = t_1 t_2 t_3 \ldots t_{n-1} r^{n-1} \Rightarrow t_n = t_1 r^{n-1}$; but $t_1 = a$.

$\therefore$ General term $= t_n = ar^{n-1}$.

Thus, if $a$ is the first term and $r$ the common ratio of a G.P. then the G.P. is $a, ar, ar^2, \ldots, ar^{n-1}$ or $a, ar, ar^2, \ldots$ according as it is fnite or infinite.

**Cor.** If the last term of a G.P. consisting of $n$ terms is denoted by $l$, then $l = ar^{n-1}$.

**Notes:**

- If $a$ is the first term and $r$ the common ratio of a finite G.P. consisting of $m$ terms, then the $n$th term from the end is given by $ar^{m-n}$.
- The $n$th term from the end of a G.P. with the last term $l$ and common ratio $r$ is $l/r^{n-1}$.
- Three numbers in G.P. can be taken as $a/r, a, ar$; four numbers in G.P. can be taken as $a/r^3, a/r, ar, ar^3$; five numbers in G.P. can be taken as $a/r^2, a/r, a, ar, ar^2$, and so on...
- Three numbers $a, b, c$ are in G.P. if and only if $b/a = c/b$, i.e., if and only if $b^2 = ac$.

**Illustration 10:** Find the $n$th term and 12th term of the sequence –6, 18, –54, ....

**Solution:** The given sequence is a G.P. with $a = -6$ and $r = -3$.

$$\therefore\quad t_n = ar^{n-1} = (-6)(-3)^{n-1} = (-1)^n \cdot 6 \cdot 3^{n-1}$$

For the 12th term, putting $n = 12$, we get

$$t_{12} = (-1)^{12} \cdot 6 \cdot 3^{11} = 2 \cdot 3^{12}.$$

### Sum of n terms of a G.P.

The sum of first $n$ terms of a G.P. with first term $a$ and common ratio $r$ is given by $S_n = \frac{a(r^n - 1)}{r - 1}$

**Notes:**

(i) When $r = 1$

$$S_n = a + a + \ldots \text{ up to } n \text{ terms} = na$$

(ii) It $l$ is the last term of the G.P., then

$$S_n = \frac{lr - a}{r - a},\ r \neq 1$$

### Sum of an infinite G.P. when | r | < 1

The sum of an infinite G.P. with first term $a$ and common ratio $r$ is $S_\infty = \frac{a}{1-r}$; when $|r| < 1$, i.e., $-1 < r < 1$.

**Illustration 11:** Find the sum of 8 terms and $n$ terms of the sequence 9, –3, 1, –1/3, ....

**Solution:** The given sequence is a G.P. with $a = 9$ and $r = -\frac{1}{3}$.

We know that

$$S_8 = 9\frac{1-(-1/3)^8}{1-(-1/3)} == \frac{1-1/3^8}{4/3} = \frac{27}{4}\left(1 - \frac{1}{3^8}\right)$$

$$= \frac{27}{4}\frac{3^8-1}{3^8} = \frac{1}{4}\frac{6561-1}{3^5} = \frac{6560}{4\times 243} = \frac{1640}{243}.$$

Also, $S_n = 9\,\dfrac{1-(-1/3)^n}{1-(-1/3)} = 9\dfrac{1-(-1)^n/3^n}{4/3}$.

$$= \frac{27}{4}\frac{3^n-(-1)^n}{3^n} = \frac{3^n-(-1)^n}{4\cdot 3^{n-3}}.$$

**Illustration 12:** Find the sum of the infinite sequence $7, -1, \frac{1}{7}, -\frac{1}{49}, \ldots$

**Solution:** The given sequence is a G.P. with $a = 7$ and $r = -\frac{1}{7}$, so $|r| = \left|-\frac{1}{7}\right| = < 1$.

$$\therefore \quad S = \frac{7}{1-(-\frac{1}{7})} = \frac{7}{8/7} = \frac{49}{8}. \qquad \left(\because S = \frac{a}{1-r}\right)$$

## HARMONIC PROGRESSION

A sequence of non-zero numbers $a_1, a_2, a_3, \ldots$ is said to be a *harmonic* progression (abbreviated as H.P.) if the sequence $\frac{1}{a_1}, \frac{1}{a_2}, \frac{1}{a_3}, \ldots$ is an A.P.

**Illustration 13:** The sequence $1, \frac{1}{4}, \frac{1}{7}, \frac{1}{10}, \ldots$ is a H.P. The sequence obtained by taking reciprocals of its corresponding terms, i.e., 1, 4, 7, 10, ... is an A.P.

A general H.P. is $\frac{1}{a}, \frac{1}{a+d}, \frac{1}{a+2d}, \ldots$

### *n*th term of an H.P.

*n*th term of H.P.

$$= \frac{1}{n\text{th term of the corresponding A.P.}}$$

**Notes:**

- Three numbers $a, b, c$ are in H.P. if and only if $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in A.P., i.e.,

  $$\frac{1}{a} + \frac{1}{c} = 2\cdot\frac{1}{b} \quad \text{or} \quad b = \frac{2ac}{a+c}.$$
- No term of H.P. can be zero.
- There is no general formula for finding the sum to $n$ terms of H.P.
- Reciprocals of terms of H.P. are in A.P. and then properties of A.P. can be used.

**Illustration 14:** Find the 100th of the squence

$$1, \frac{1}{3}, \frac{1}{5}, \frac{1}{7}, \ldots$$

**Solution:** The sequence $1, \frac{1}{3}, \frac{1}{5}, \frac{1}{7}, \ldots$ is an H.P.

Corresponding A.P. is 1, 3, 5, 7, ...

Now, for the corresponding A.P., first term $a = 1$, $d = 2$.

$\therefore$ 100th term of the corresponding A.P.

$= a + (100 - 1)d$

$= 1 + (100 - 1)\,2 = 199$

Hence, the 100th term of the given sequence $= \frac{1}{199}$.

### Some Special Sequences

1. The sum of first $n$ natural numbers

$$\Sigma n = 1 + 2 + 3 + \ldots + n = \frac{n(n+1)}{2}$$

2. The sum of squares of first $n$ natural numbers $\Sigma n^2$

$$= 1^2 + 2^2 + 3^2 + \ldots + n^2 = \frac{n(n+1)(2n+1)}{6}.$$

3. The sum of cubes of first $n$ natural numbers $\Sigma n^3 =$

$$1^3 + 2^3 + 3^3 + \ldots + n^3 = \left[\frac{n(n+1)}{2}\right]^2.$$

**Note:**

If $n$th term of a sequences is

$$T_n = an^3 + bn^2 + cn + d$$

then the sum of $n$ terms is given by

$$S_n = \Sigma T_n = a\Sigma n^3 + b\Sigma n^2 + c\Sigma n + \Sigma d,$$

which can be evaluated using the above results.

**Illustration 15:** Find $2^2 + 4^2 + 6^2 + \ldots + (2n)^2$.

**Solution:** $n$th term of the given series is $(2n)^2$. Then, $T_n = 4n^2$.

$$\therefore \quad S_n = 4\,\Sigma\, n^2 = \frac{4n(n+1)(2n+1)}{6}$$

$$\therefore \quad S_n = \frac{2n(n+1)(2n+1)}{3}.$$

**Illustration 16:** Sum the series $1^2 + (1^2+2^2) + (1^2+2^2+3^2) + \ldots$ to $n$ terms.

**Solution:** Here, $T_n = (1^2 + 2^2 + 3^2 + \dots n^2)$

$$= \Sigma n^2 = \frac{n(n+1)(2n+1)}{6}$$

$$= \frac{n(2n^2+3n+1)}{6}$$

$$= \frac{1}{3}n^3 + \frac{1}{2}n^2 + \frac{1}{6}n.$$

$$\therefore \quad S_n = \Sigma\left(\frac{1}{3}n^3 + \frac{1}{2}n^2 + \frac{1}{6}n\right)$$

$$= \frac{1}{3}\Sigma n^3 + \frac{1}{2}\Sigma n^2 + \frac{1}{6}\Sigma n$$

$$= \frac{1}{3}\frac{n^2(n+1)^2}{4} + \frac{1}{2}\frac{n(n+1)(2n+1)}{6} + \frac{1}{6}\frac{n(n+1)}{2}$$

$$= \frac{n(n+1)}{12}[n(n+1) + 2n + 1 + 1]$$

$$= \frac{n(n+1)}{12}(n^2 + 3n + 2)$$

$$= \frac{n(n+1)}{12}(n+1)(n+2)$$

$$= \frac{n}{12}(n+1)^2(n+2).$$

## EXERCISE-I

1. Determine 25th term of an A.P. whose 9th term is $-6$ and common difference is $\frac{5}{4}$.
   (a) 16 (b) 18
   (c) 12 (d) 14
2. Which term of the A.P. 5, 13, 21, ... is 181?
   (a) 21st (b) 22nd
   (c) 23rd (d) 24th
3. Find the $n$th term of the series:
   $\frac{1}{n} + \frac{n+1}{n} + \frac{2n+1}{n} + \dots$
   (a) $\frac{3+n^2+n}{n}$ (b) $\frac{1+n^2-n}{n}$
   (c) $\frac{2+n^2-n}{n}$ (d) None of these
4. If the $p$th term of an A.P. is $q$ and the $q$th term is $p$, then its $r$th term is:
   (a) $p + q - r$ (b) $p - q - r$
   (c) $r + q + p$ (d) None of these
5. Determine $k$ so that $\frac{2}{3}$, $k$ and $\frac{5}{8}k$ are the three consecutive terms of an A.P.
   (a) $\frac{16}{33}$ (b) $\frac{14}{33}$
   (c) $\frac{12}{33}$ (d) $\frac{18}{33}$
6. Determine $k$, so that $k + 2$, $4k - 6$ and $3k - 2$ are three consecutive terms of an A.P.
   (a) 5 (b) 7
   (c) 9 (d) 3
7. The ratio of the 7th to the 3rd term of an A.P. is 12:5. Find the ratio of 13th to the 4th term.
   (a) 8:5 (b) 9:4
   (c) 7:3 (d) 10:3
8. If 7 times the 7th term of an A.P. is equal to 11 times its 11th term, then the 18th term of the A.P. is:
   (a) 1 (b) 2
   (c) 0 (d) 3
9. The 4th term of an A.P. is equal to 3 times the first term and the seventh term exceeds twice the third term by 1. Find the first term and the common difference.
   (a) 3, 2 (b) 5, 2
   (c) 7, 3 (d) 9, 3
10. If the 9th term of an A.P. is 99 and 99th term is 9, find 108th term.
    (a) 0 (b) 2
    (c) 4 (d) 6
11. If the $p$th, $q$th and $r$th terms of an A.P. are $a$, $b$, $c$, respectively, find the value of:
    $a(q - r) + b(r - p) + c(p - q)$
    (a) 2 (b) 1
    (c) 0 (d) 3
12. A body falls 16 m in the first second of its motion, 48 m in the second, 80 m in the third, 112 m in the fourth and so on. How far does it fall during the 11th second of its motion?
    (a) 338 m (b) 340 m
    (c) 334 m (d) 336 m

**13.** A ball rolling up an incline covers 36 meters during the first second, 32 m during the second, 28 m during the next and so on. How much distance will it travel during the 8th second?

(a) 8 m (b) 6 m
(c) 7 m (d) 9 m

**14.** Determine the sum of the first 35 terms of an A.P. if $t_2 = 2$ and $t_7 = 22$.

(a) 2510 (b) 2310
(c) 2710 (d) 2910

**15.** If the 5th and the 12th terms of an A.P. are 30 and 65, respectively, then what is the sum of the first 20 terms?

(a) 1175 (b) 1250
(c) 1150 (d) 1350

**16.** If the 12th term of an A.P. is −13 and the sum of the first four terms is 24, then what is the sum of the first 10 terms?

(a) 0 (b) 2
(c) 1 (d) 4

**17.** The sum of a series in A.P. is 525. Its first term is 3 and last term is 39. Find the common difference.

(a) 3/2 (b) 3/3
(c) 2/3 (d) 1/3

**18.** Find the common difference of an A.P. whose first term is 100 and the sum of whose first six terms is five times the sum of the next six terms.

(a) −15 (b) −10
(c) −20 (d) −5

**19.** How many terms are there in an A.P. whose first and fifth terms are −14 and 2, respectively and the sum of terms is 40?

(a) 15 (b) 5
(c) 10 (d) 20

**20.** Sum the series

51 + 50 + 49 + ... + 21

(a) 1116 (b) 1122
(c) 1128 (d) 1124

**21.** The sum of $p$ terms of an A.P. is $3p^2 + 4p$. Find the $n$th term.

(a) $5n + 2$ (b) $6n + 1$
(c) $8n + 3$ (d) $7n + 3$

**22.** How many terms of the A.P. 1, 4, 7, ... are needed to give the sum 715?

(a) 33 (b) 22
(c) 24 (d) 27

**23.** Find the sum of the first hundred even natural numbers divisible by 5.

(a) 50575 (b) 50560
(c) 50500 (d) 50505

**24.** Find the sum of all integers between 50 and 500 which are divisible by 7.

(a) 17966 (b) 1177996
(c) 17766 (d) 17696

**25.** Find the sum of the numbers of three digits divisible by 7.

(a) 70334 (b) 70338
(c) 70336 (d) 70332

**26.** Find the sum of all odd numbers of four digits which are divisible by 9.

(a) 2754000 (b) 2754004
(c) 2754008 (d) 2754000

**27.** Which term of the geometric sequence

$\frac{1}{3}, \frac{1}{9}, \frac{1}{27}, ....$ is $\frac{1}{19683}$?

(a) 9 (b) 7
(c) 11 (d) 13

**28.** Find the 10th term of the geometric series 5 + 25 + 125 + ...,

(a) $5^{10}$ (b) $5^9$
(c) $5^{11}$ (d) $5^8$

**29.** Write down the 20th term of the G.P. 1, −1, 1, −1, ...

(a) 1 (b) −1
(c) + 1 (d) None of these

**30.** Write down the 5th term of the series $\frac{1}{4} - \frac{1}{2} + 1$ ...

(a) 6 (b) 8
(c) 4 (d) 10

**31.** The 5th term of a G.P. is 2, find the product of first 9 terms.

(a) 508 (b) 512
(c) 504 (d) 516

**32.** What term of progression

18, −12, 8, ... is $\frac{512}{729}$?

(a) 15 (b) 18
(c) 9 (d) 12

**33.** The 3rd term of a G.P. is the square of the first term. If the second term is 8, determine the 6th term.

(a) 136 (b) 132
(c) 128 (d) 124

**34.** If 4th and 8th terms of a G.P. are 24 and 384, respectively, then find out the first term and common ratio.

(a) 2, 3 (b) 5, 3
(c) 3, 2 (d) None of these

**35.** The first term of a G.P. is 1. The sum of the third and fifth terms is 90. Find the common ratio of the G.P.

(a) 2, –3 (b) 3, –3
(c) 1, –3 (d) 5, –3

**36.** For what value of $x$, the numbers $-\frac{2}{7}, x, -\frac{7}{2}$ are in G.P.?

(a) 1, –2 (b) 1, –3
(c) 1, –5 (d) 1, –1

**37.** A person has two parents (father and mother), four grandparents, eight great grandparents and so on. Find the number of ancestors the person has up to the 10th generation.

(a) 1028 (b) 1024
(c) 1030 (d) 1026

**38.** In a G.P, the first term is 7, the last term 448 and the sum 889. Find the common ratio.

(a) 4 (b) 6
(c) 8 (d) 2

**39.** The sum of first three terms of a G.P. is to the sum of first six terms is 125:152. Find the common ratio of G.P.

(a) $\frac{2}{5}$ (b) $\frac{4}{5}$
(c) $\frac{3}{5}$ (d) $\frac{1}{5}$

**40.** Evaluate $\sum_{j=1}^{11} (2+3^j)$

(a) $22 + \frac{3}{2}(3^{11} - 1)$ (b) $11 + \frac{3}{2}(3^{11} - 1)$
(c) $22 + \frac{3}{2}(3^{10} - 1)$ (d) None of these

**41.** The sum of the first two terms of a G.P. is 36 and the product of the first and the third terms is 9 times the second term, then find the sum of the first 8 terms.

(a) $\frac{3480}{81}$ (b) $\frac{3280}{81}$
(c) $\frac{3680}{81}$ (d) $\frac{3880}{81}$

**42.** The common ratio of a G.P. is $-\frac{4}{5}$ and the sum to infinity is $\frac{80}{9}$. Find the first term.

(a) 14 (b) 16
(c) 14 (d) 10

**43.** Sum the series to infinity

$$\frac{3}{4} - \frac{5}{4^2} + \frac{3}{4^3} - \frac{5}{4^4} + \frac{3}{4^5} - \frac{5}{45} + \ldots$$

(a) $\frac{8}{15}$ (b) $\frac{7}{17}$
(c) $\frac{7}{15}$ (d) $\frac{8}{17}$

**44.** The product $(32)\,(32)^{1/6}\,(32)^{1/36} \ldots \infty$ is equal to:
(a) 16 (b) 64
(c) 32 (d) 0

**45.** Find the 9th term of the H.P. 6, 4, 3, ...

(a) $\frac{7}{5}$ (b) $\frac{6}{5}$
(c) $\frac{5}{6}$ (d) None of these

**46.** Find the $n$th term of the H.P. whose first two terms are 6 and 3, respectively.

(a) $\frac{6}{n}$ (b) $\frac{7}{n}$
(c) $\frac{5}{n}$ (d) $\frac{8}{n}$

**47.** If $x > 1$, $y > 1$, $z > 1$ are in G.P., then $\frac{1}{1+\log x}, \frac{1}{1+\log y}, \frac{1}{1+\log z}$ are in

(a) A.P. (b) H.P.
(c) G.P. (d) None of these

**48.** $\frac{2}{5} + \frac{3}{5^2} + \frac{2}{5^3} + \frac{3}{5^4} + \ldots \infty$

(a) $\frac{17}{24}$ (b) $\frac{15}{24}$
(c) $\frac{13}{24}$ (d) $\frac{11}{24}$

**49.** If the first term of a G.P. is 729 and 7th term is 64, determine $S_7$.
(a) 2259 (b) 3059
(c) 2059 (d) 2459

**50.** If $a$ be the first term of a G.P., $l$ the $n$th term and $P$ the product of first $n$ terms then $P$ =

(a) $(al)^{n/2}$ (b) $(a - l)^{n/2}$
(c) $(a + l)^{n/2}$ (d) None of these

## EXERCISE-2
## (BASED ON MEMORY)

1. The sum 5 + 6 + 7 + 8 + ··· + 19 is equal to
(a) 150 (b) 170
(c) 180 (d) 190
**[SSC (GL) Prel. Examination, 2005]**

2. Given that $1^2 + 2^2 + 3^2 + \cdots + 20^2 = 2870$, the value of $(2^2 + 4^2 + 6^2 + \cdots + 40^2)$ is
(a) 11480 (b) 5740
(c) 28700 (d) 2870
**[SSC (GL) Prel. Examination, 2005]**

3. Which term of the series 72 + 63 + 54 + ···. is zero?
(a) 11th (b) 10th
(c) 9th (d) 8th
**[SSC (GL) Prel. Examination, 2000]**

4. What is the 507th term of the sequence:
1, −1, 2, −2, 1, −1, 2, −2, 1,... ?
(a) −1 (b) 1
(c) −2 (d) 2
**[SSC (GL) Prel. Examination, 2000]**

5. If the 4th term of an A.P. is 14 and the 12 term is 70, then the first term is:
(a) −10 (b) −7
(c) 7 (d) 10
**[SSC (GL) Prel. Examination, 2000]**

6. $[14^2 + 15^2 + \cdots + 30^2]$ is equal to:
(a) 6836 (b) 8336
(c) 8336 (d) 8636
**[SSC (GL) Prel. Examination, 2000]**

7. If $1^3 + 2^3 + \cdots + \cdots 10^3 = 3025$,
then 4 + 32 + 108 + ··· + 4000 is equal to:
(a) 12000 (b) 12100
(c) 12200 (d) 12400
**[SSC (GL) Prel. Examination, 2002]**

8. If $1^2 + 2^2 + 3^2 + \cdots + 10^2 = 385$, then
$3^2 + 6^2 + 9^2 + \cdots + 30^2$ is equal to
(a) 3465 (b) 2310
(c) 1155 (d) 770
**[SSC (GL) Prel. Examination, 2002]**

9. If $1^2 + 2^2 + 3^2 + \cdots + x^2 = \dfrac{x(x+1)(2x+1)}{6}$, then
$1^2 + 3^2 + 5^2 + \cdots + 19^2$ is equal to
(a) 1330 (b) 2100
(c) 2485 (d) 2500

10. If $1^3 + 2^3 + \cdots + 9^3 = 2025$, then the value of $(0.11)^3 + (0.22)^3 + \cdots + (0.99)^3$ is close to:
(a) 0.2695 (b) 2.695
(c) 3.695 (d) 0.3695
**[SSC (GL) Prel. Examination, 2002]**

11. If log 2, log $(2^x - 1)$ and log $(2^x + 3)$ (all to the base 10) be three consecutive terms of an Arithmetic Progression, then the value of $x$ is equal to:
(a) 0 (b) 1
(c) $\log_2 5$ (d) $\log_{10} 2$

12. $(1^2 + 2^2 + 3^2 + \cdots + 10^2)$ is equal:
(a) 380 (b) 385
(c) 390 (d) 392
**[SSC (GL), 2010]**

13. The sum of the series (1 + 0.6 + 0.06 + 0.006 + 0.0006 + ···) is:
(a) $1\frac{2}{3}$ (b) $1\frac{1}{3}$
(c) $2\frac{1}{3}$ (d) $2\frac{2}{3}$
**[SSC (GL), 2010]**

14. The 9th term of the sequence, 0, 3, 8, 15, 24, 35, ··· is
(a) 63 (b) 70
(c) 80 (d) 99
**[SSC (GL), 2010]**

15. Find the sum of all positive multiples of 3 less than 50.
(a) 400 (b) 404
(c) 408 (d) 412
**[SSC, 2014]**

**16.** Find the sum of $\left(1-\frac{1}{n+1}\right)+\left(1-\frac{2}{n+1}\right)+\left(1-\frac{3}{n+1}\right)+\cdots+\left(1-\frac{n}{n+1}\right)$.

(a) $n$ (b) $\frac{1}{2}n$
(c) $(n + 1)$ (d) $\frac{1}{2}(n+1)$

**[SSC, 2013]**

**17.** If a clock strikes appropriate number of times at each hour, how many times will it strike in a day?

(a) 300 (b) 156
(c) 68 (d) 78

**[SSC, 2013]**

**18.** Terms $a$, 1, $b$ are in arithmetic progression and terms 1, $a$, $b$ are in geometric progression. Find $a$ and $b$ (given $a \neq b$).

(a) 2, 4 (b) −2, 1
(c) 4, 1 (d) −2, 4

**[SSC Assistant grade III, 2013]**

**19.** The sum $11^2 + 12^2 + \cdots$ v $+ 21^2 = ?$

(a) 2926 (b) 3017
(c) 3215 (d) 3311

**[SSC, 2012]**

**20.** $\left[\frac{1}{1\times2}+\frac{1}{2\times3}+\frac{1}{3\times4}+\cdots+\frac{1}{99\times100}\right]$ is equal to:

(a) $\frac{1}{9900}$ (b) $\frac{99}{100}$
(c) $\frac{100}{99}$ (d) $\frac{1000}{99}$

**[SSC, 2010]**

**21.** The sum of all the digits of the numbers from 1 to 100 is:

(a) 5050 (b) 903
(c) 901 (d) 900

**[SSC, 2010]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (a) | **3.** (b) | **4.** (a) | **5.** (a) | **6.** (d) | **7.** (d) | **8.** (c) | **9.** (a) | **10.** (a) | **11.** (c) | **12.** (d) | **13.** (a) |
| **14.** (b) | **15.** (c) | **16.** (a) | **17.** (a) | **18.** (b) | **19.** (c) | **20.** (a) | **21.** (b) | **22.** (b) | **23.** (c) | **24.** (d) | **25.** (c) | **26.** (a) |
| **27.** (a) | **28.** (a) | **29.** (b) | **30.** (c) | **31.** (b) | **32.** (c) | **33.** (c) | **34.** (c) | **35.** (b) | **36.** (d) | **37.** (b) | **38.** (d) | **39.** (c) |
| **40.** (a) | **41.** (b) | **42.** (b) | **43.** (c) | **44.** (b) | **45.** (b) | **46.** (a) | **47.** (b) | **48.** (c) | **49.** (c) | **50.** (a) | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (d) | **2.** (b) | **3.** (c) | **4.** (d) | **5.** (b) | **6.** (d) | **7.** (b) | **8.** (a) | **9.** (a) | **10.** (b) | **11.** (c) | **12.** (b) | **13.** (a) |
| **14.** (c) | **15.** (c) | **16.** (b) | **17.** (b) | **18.** (d) | **19.** (a) | **20.** (b) | **21.** (a) | | | | | |

## EXPLANATORY ANSWERS

### Exercise-1

**1.** **(d)** Let, $a$ be the first term and $d$ the common difference of an A.P.

Then, $a_n = a + (n - 1)\, d$

$$a_9 = a + (9 - 1)\left(\frac{5}{4}\right)$$

$\Rightarrow$ $a_9 = a + 10$

$\Rightarrow$ $-6 = a + 10$

$\Rightarrow$ $a = -6 - 10 = -16$

$\therefore$ $a_{25} = -16 + (25 - 1)\frac{5}{4} = -16 + 30 = 14.$

**2.** **(c)** Here, first term $a = 5$

Common difference $d = 8$

Let, 181 be the $n$th, i.e., $a_n = 181$

$\therefore$ $181 = 5 + (n - 1)8$ or, $176 = (n - 1)8$

$\therefore \quad n - 1 = 176 \div 8 = 22$

$\therefore \quad n = 23$

Hence, 181 is the 23rd term.

**3.** **(b)** Here $a_1 = \frac{1}{n}$, $d = \frac{n+1}{n} - \frac{1}{n} = 1$

$\therefore \quad a_n = a + (n - 1)d$

$\therefore \quad a_n = \frac{1}{n} + n - 1 = \frac{1 + n^2 - n}{n}$.

**4.** **(a)** Let, '$a$' be the first term and $d$, the common difference

$\therefore \quad a_p = q \quad \Rightarrow \quad a + (p - 1)\, d = q \qquad \ldots(1)$

$a_q = p \quad \Rightarrow \quad a + (q - 1)\, d = p \qquad \ldots(2)$

Subltracting (2) from (1)

$(p - q)\, d = q - p = -\,(p - q)$

$\therefore \quad d = -1$

$\therefore$ From (1), $a + (p - 1)(-1) = q$

i.e., $a - p + 1 = q$

$\therefore \quad a = p + q - 1$

$\therefore \quad a_r = a + (r - 1)d$

$= (p + q - 1) + (r - 1)(-1)$

$= p + q - 1 - r + 1$

$= p + q - r.$

**5.** **(a)** $\because \quad \frac{2}{3}, k, \frac{5}{8} k$ are in A.P.

$\therefore \quad k - \frac{2}{3} = \frac{5}{8} k - k \quad \Rightarrow \quad \frac{5k}{8} - 2k = \frac{-2}{3}$

$\Rightarrow \quad \frac{-11k}{8} = \frac{-2}{3} \Rightarrow k = \frac{16}{33}$

**6.** **(d)** $\because \quad k + 2, 4k - 6, 3k - 2$ are in A.P.

$\therefore \quad (4k - 6) - (k + 2) = (3k - 2) - (4k - 6)$

$\Rightarrow \quad 3k - 8 = -\,k + 4$

$\therefore \quad 4k = 12 \quad \therefore \quad k = 3.$

**7.** **(d)** Let, $a$ be the first term and $d$ the common difference of the A.P. Then,

$\frac{a + 6d}{a + 2d} = \frac{12}{5} \quad \Rightarrow \quad 5a + 30d = 12a + 24d$

$\Rightarrow \quad -7a + 6d = 0$

$\Rightarrow \quad a = \frac{6}{7} d$

$\therefore \quad \frac{\text{13th term}}{\text{4th term}} = \frac{a + 12d}{a + 3d} = \frac{\frac{6}{7}d + 12d}{\frac{6}{7}d + 3d}$

$= \frac{90}{27} = \frac{10}{3}$.

**8.** **(c)** Let, $a$ be the first term and $d$, the common difference of an A.P.

$\therefore \quad a_7 = a + 6d$

$a_{11} = a + 10d \quad \because \quad 7a_7 = 11a_{11}$

$\therefore \quad 7(a + 6d) = 11(a + 10d)$

$\Rightarrow \quad 7a + 42d = 11a + 110d$

$\Rightarrow \quad -\,4a = 68d$

$\therefore \quad a = -\,17d \qquad \ldots(1)$

Now, $a_{18} = a + 17d = -17d + 17d$ [Using (1)]

$= 0.$

**9.** **(a)** Let, $a$ be the first term and $d$ the common difference of A.P.

$\because \quad a_4 = 3a, \quad \therefore \quad a + 3d = 3a$

$\Rightarrow \quad 2a = 3d, \quad \therefore \quad a = \frac{3}{2} d \qquad \ldots(1)$

Also, $a_7 = 2a_3 + 1$

$\Rightarrow \quad a + 6d = 2\,(a + 2d) + 1$

$\Rightarrow \quad a + 6d = 2a + 4d + 1$

$\therefore \quad a = 2d - 1 \qquad \ldots(2)$

From (1) and (2), $\frac{3}{2} d = 2d - 1 \Rightarrow 2d - \frac{3}{2} d = 1$

$\therefore \quad \frac{d}{2} = 1 \quad \Rightarrow \quad d = 2 \quad \therefore \quad a = \frac{3}{2} d = \frac{3}{2} \times 2 = 3.$

**10.** **(a)** Let, $a$ be the first term and $d$ the common difference of A.P.

$\because \quad a_9 = 99$

$\therefore \quad a + 8d = 99 \qquad \ldots(1)$

Also, $a_{99} = 9 \quad \therefore \quad a + 98d = 9 \qquad \ldots(2)$

Subtracting (2) from (1)

$-90\; d = 90$

$\therefore \quad d = -1 \qquad \ldots(3)$

Substituting this value of $d$ in (1)

$a + 8(-1) = 99 \Rightarrow a = 99 + 8 = 107 \qquad \ldots(4)$

$\therefore \quad a_{108} = a + (108 - 1)\, d = 107 + 107\,(-1) = 0.$

**11.** **(c)** Let, $A$ be the first term and $D$, the common difference of A.P.

$a_p = a, \quad \therefore \quad A + (p - 1)\, D = a \qquad \ldots(1)$

$a_q = b, \quad \therefore \quad A + (q - 1)\, D = b \qquad \ldots(2)$

$a_r = c, \quad \therefore \quad A + (r - 1)\, D = c \qquad \ldots(3)$

$\therefore \quad a(q - r) + b(r - p) + c(p - q)$

$= [A + (p - 1)\, D]\,(q - r) + [A + (q - 1)\, D]\,(r - p) + [A + (r - 1)\, D]\,(p - q)$

$= (q - r + r - p + p - q)\, A + [(p - 1)(q - r) + (q - 1)(r - p) + (r - 1)(p - q)]D$

$= OA + OD = 0.$

**12.** **(d)** The distances through which the body falls in first, second, third, fourth, ..... seconds form an A.P. $16 + 48 + 80 + 112 + \cdots$

Here, $a = 16$, $d = 32$

Distance through which it falls in 11th second

$= 11$ the term of the A.P.

$= a + 10d = 16 + 10\,(32)$

$= 16 + 320 = 336$ m.

**13. (a)** Distance covered during the first second 36 m

Distance covered during the 2nd second = 32m

Distance covered during the 3rd second = 28m

The distance covered form an A.P.

$= 36 + 32 + 28 + \cdots$ in which

$a = 36$, $d = -4$

$\therefore$ Distances covered in 8th second

= 8th term of the A.P.

$= a + 7d = 36 + 7(-4)$

$= 36 - 28 = 8$ m.

**14. (b)** Let, $a$ and $d$ be the first term and the common difference, respectively.

$\because \quad t_n = a + (n - 1)d,$

$\therefore \quad t_2 = a + (2 - 1)\,d = 2 \;\Rightarrow\; a + d = 2$ ...(1)

and, $t_7 = a + (7 - 1)\,d = 22 \;\Rightarrow\; a + 6d = 22$ ...(2)

Subtracting (1) from (2), we get

$5d = 20 \Rightarrow d = 4$

$\therefore \quad a + 4 = 2 \;\Rightarrow\; a = 2 - 4 = -2$ [Using (1)]

Now, $S_n = \dfrac{n}{2}\,[2a + (n - 1)d]$

$\therefore \quad S_{35} = \dfrac{35}{2}\,[-4 + (35 - 1)4]$

$= \dfrac{35}{2} \times 132, = 35 \times 66 = 2310.$

**15. (c)** Let, $a$ be the first term and $d$ the common difference of an A.P., then

$a_5 = a + 4d = 30$ ...(1)

$a_{12} = a + 11d = 65$ ...(2)

Subtracting (1) from (2), we get

$7d = 35 \;\Rightarrow\; d = 5$

$\therefore$ From (1)

$a + 4\,(5) = 30 \;\Rightarrow\; a = 30 - 20 = 10$

Now, $S_n = \dfrac{n}{2}\,[2a + (n - 1)d]$

$\therefore \quad S_{20} = \dfrac{20}{2}[2 \times 10 + (20 - 1)5]$

$= 10\,[20 + 95] = 1150.$

**16. (a)** Let, $a$ be the first term and $d$ the common difference of the A.P.

Then, $n$th term $= a + (n - 1)d$

$\therefore \quad a_{12} = a + 11d = -13$ ...(1)

Again, $S_n = \dfrac{n}{2}\,[\,2a + (n - 1)d]$

$\therefore \quad S_4 = 2(2a + 3d)$

But $S_4 = 24$

$\therefore \quad 2(2a + 3d) = 24$

$\Rightarrow \quad 2a + 3d = 12$ ...(2)

Multiplying (1) by 2, we get

$2a + 22d = -\,26$ ...(3)

Subtracting (2) from (3)

$19d = -38 \;\Rightarrow\; d = -2$

Substituting $d = -2$ in (1), we get

$a + 11 \times (-2) = -13 \;\Rightarrow\; a = -13 + 22 = 9$

$\therefore \quad S_{10} = \dfrac{10}{2}\,[2 \times 9 + (10 - 1) \times -2]$

$= 5\,(18 - 18) = 0.$

**17. (a)** If $n$ be the number of terms, then

$$a_n = a + (n - 1)d,$$

where $a$ is the first term and $d$ the common difference.

$\therefore \quad 39 = 3 + (n - 1)d$

or, $\quad (n - 1)d = 36$ ...(1)

Also, $S_n = \dfrac{n}{2}\,[a_1 + a_n]$

$\therefore \quad 525 = \dfrac{n}{2}[\,3 + 39] \;\Rightarrow\; 1050 = n\,(42)$

or, $\quad n = \dfrac{1050}{42} = 25$

Putting $n = 25$ in (1), we get

$(25 - 1)d = 36 \;\Rightarrow\; d = 36 \div 24 = \dfrac{3}{2} = 1\dfrac{1}{2}.$

**18. (b)** Here, $a = 100$

Let, $d$ be the common difference

Now, $a_1 + a_2 + a_3 + a_4 + a_5 + a_6$

$= 5(a_7 + a_8 + a_9 + a_{10} + a_{11} + a_{12})$

$\Rightarrow \quad 6\left(\dfrac{a_1 + a_6}{2}\right) = 5 \times 6\left(\dfrac{a_7 + a_{12}}{2}\right)$

$\Rightarrow \quad a_1 + a_6 = 5\,(\,a_7 + a_{12})$

$\Rightarrow \quad a + a + 5d = 5[a + 6d + a + 11d]$

$\Rightarrow \quad 2a + 5d = 10a + 85d$

$\Rightarrow \quad 80d = -8a$ or, $d = \dfrac{-a}{10}$

$\therefore \quad d = \dfrac{-100}{10} = -10.$

**19. (c)** Here, $a = -14$

Let, $d$ be the common difference

$a_5 = 2 \;\Rightarrow\; a + 4d = 2 \;\Rightarrow\; -14 + 4d = 2$

$\therefore \quad d = 4$

Let 40 be the sum of $n$ terms of this A.P.

$\because \quad S_n = \frac{n}{2}[2a + (n-1)d]$

$\therefore \quad 40 = \frac{n}{2}[2(-14) + (n-1)4] \quad \Rightarrow \quad 80 = n(4n - 32)$

or, $\quad 4n^2 - 32n - 80 = 0 \quad \Rightarrow \quad n^2 - 8n - 20 = 0$

$\Rightarrow \quad (n+2)(n-10) = 0$

$\therefore \quad n = 10$ or, $-2$. But $n \neq -2$.

Hence, the required number of terms are 10.

**20.** **(a)** Here, $a = 51$, $d = -1$, $a_n = 21$

Now, $a_n = a_1 + (n-1)d$

or, $\quad 21 = 51 - n + 1 \quad \therefore \quad n = 52 - 21 = 31$

Now, $S_n = \frac{n}{2}(a_1 + a_n) = \frac{31}{2}(51 + 21)$

$$= \frac{31}{2} \times 72 = 31 \times 36 = 1116.$$

**21.** **(b)** Here, $S_p = 3p^2 + 4p$ Putting $p = n$, we have

$$S_n = 3n^2 + 4n$$

Changing $n$ to $(n-1)$, we get

$S_{n-1} = 3(n-1)^2 + 4(n-1)$

$= 3(n^2 - 2n + 1) + 4n - 4$

$= 3n^2 - 2n - 1$

$\therefore \quad a_n = S_n - S_{n-1}$

$$= 3n^2 + 4n - 3n^2 + 2n + 1 = 6n + 1.$$

**22.** **(b)** Here, $a = 1$, $d = 3$,

Let, 715 be the sum of $n$ terms of this A.P.

That is, $S_n = 715$

$\therefore \quad \frac{n}{2}[2a + (n-1)d] = 715$

Putting values, of $a$ and $d$

$$\frac{n}{2}[2 \times 1 + (n-1) \times 3] = 715$$

$\Rightarrow \quad \frac{n}{2}[2 + 3n - 3] = 715$

$\Rightarrow \quad 3n^2 - n - 1430 = 0$

$\therefore \quad n = \frac{1 \pm \sqrt{1 - 4(3)(-1430)}}{2 \times 3}$

$$= \frac{1 \pm \sqrt{17161}}{6} = \frac{1 \pm 131}{6}$$

$\therefore \quad n = \frac{1 + 131}{6} = 22, \; n = \frac{1 - 131}{6} = \frac{-65}{3}$

But $n \neq \frac{-65}{3} \quad \therefore \quad n = 22.$

**23.** **(c)** Even natural numbers which are divisible by 5 are 10, 20, 30, 40,....

They form an A.P. with $a = 10$, $d = 10$

$S_{100} = \frac{100}{2}[2 \times 10 + (100 - 1) \times 10]$

$$= 50(20 + 990) = 50(1010) = 50500.$$

**24.** **(d)** The first integer, after 50 which is divisible by 7 is 56 and the last integer before 500 which is divisible by 7 is 497.

$\therefore$ The sequence of integers between 50 and 500 which are divisible by 7 is 56, 63, 70, ...., 497

It is an A.P. with

$$a = 56, \; d = 7$$

$$a_n = 497 = a + (n-1)d$$

$\therefore \quad 497 = 56 + (n-1) \times 7$

$\therefore \quad 7n = 497 + 7 - 56$

or, $\quad 7n = 448$

or, $\quad n = 488 \div 7 = 64$

Required sum $= \frac{n}{2}(a_1 + a_n) = \frac{64}{2}(56 + 497)$

$$= 32 \times (553) = 17696.$$

**25.** **(c)** The least and the greatest number of three digits divisible by 7 are 105 and 994, respectively.

$\therefore$ It is required to find the sum of

$$105 + 112 + 119 + \ldots + 994$$

Here, $a = 105$, $d = 7$, $a_n = 994$

Then, $n = ?$, $S_n = ?$

Now, $a_n = a + (n-1)d$

$\Rightarrow \quad 994 = 105 + (n-1) \times 7$

$\Rightarrow \quad 994 - 105 = 7(n-1)$

$\Rightarrow \quad 889 = 7(n-1)$ or, $(n-1) = 127 \quad \Rightarrow \quad n = 128$

Also, Sum $= \frac{n}{2}[2a + (n-1)d]$

$$= \frac{128}{2}[2 \times 105 + (128 - 1) \times 7]$$

$$= 64[210 + 889]$$

$$= 64 \times 1099 = 70336.$$

**26.** **(a)** The odd numbers of four digits which are divisible by 9 are 1017, 1035, ..., 9999

These are in A.P. with common difference 18.

Hence, $n$th term $= a_n = a + (n-1)d$

$a = 1017$, $d = 18$, $l = 9999$

$\therefore \quad 9999 = 1017 + (n-1) \times 18$

$\Rightarrow \quad 18n = 9999 - 999 = 9000$

$\therefore \quad n = 9000 \div 18 = 500$

$\therefore \quad S_n = \frac{n}{2}(a_1 + a_n) = \frac{500}{2}(1017 + 9999)$

$$= 250 \times 11016 = 2754000.$$

**27. (a)** Let, $n$th term of the given sequence be $\frac{1}{19683}$. Then,

$$a_n = ar^{n-1} \Rightarrow \frac{1}{19683} = \frac{1}{3}\left(\frac{1}{3}\right)^{n-1},$$

$$\Rightarrow \left(\frac{1}{3}\right)^8 = \left(\frac{1}{3}\right)^{n-1}$$

$$\Rightarrow n - 1 = 8 \Rightarrow n = 9.$$

**28. (a)** The given geometric series is

$5 + 25 + 125 + \cdots$

$a$ = lst term = 5, $r$ = common ratio = 5

$n = 10$

$\therefore$ 10th term $= a_{10} = ar^{10-1}$

$= (5)(5)^9 = 5^{10}.$

**29. (b)** Here, $a = 1$, $r = -1$

Since $a_n = ar^{n-1}$

$\therefore \quad a_{20} = ar^{19} = 1 \times (-1)^{19} = -1.$

**30. (c)** Here, $a = \frac{1}{4}$, $r = -2$. $\because \quad a_n = ar^{n-1}$

$$\therefore \quad a_5 = \frac{1}{4} \times (-2)^4 = \frac{1}{4} \times 16 = 4.$$

**31. (b)** Let, $a$ be the first term and $r$ the common ratio

$\therefore \quad a_5 = 2 \Rightarrow ar^4 = 2$ ...(1)

Now, product of first 9 terms

$= a \times ar \times ar^2 \times ... \times ar^8$

$= a^9 \, r^{1+2+\cdots+8} = a^9 \, r^{36}$

$= (ar^4)^9 = 2^9 = 512.$

**32. (c)** Here $a = 18$, $r = \frac{-2}{3}$

Let, $\frac{512}{729}$ be the $n$th term so that $a_n = \frac{512}{729}$

Since $a_n = ar^{n-1}$

$$\therefore \quad \frac{512}{729} = 18\left(\frac{-2}{3}\right)^{n-1}$$

$$\Rightarrow \left(\frac{-2}{3}\right)^{n-1} = \frac{512}{729 \times 18} = \frac{256}{9 \times 729}$$

$$= \frac{2^8}{3^2 \times 3^6} = \left(\frac{-2}{3}\right)^8$$

$\therefore \quad n - 1 = 8 \Rightarrow n = 9$

Hence, $\frac{512}{729}$ is the 9th term of progression.

**33. (c)** Let, $a$ be the first term and $r$ be the common ratio of G.P.

We have $a_3 = (a_1)^2 \Rightarrow ar^2 = a^2$

$\Rightarrow r^2 = a$ ...(1)

Also, $a_2 = 8 \Rightarrow ar = 8$ ...(2)

Multiplying (1) and (2), we get

$ar^3 = 8 \times a \therefore r^3 = 8 \Rightarrow r = 2$

From (1) $a = (2)^2 = 4$ $[\because \quad a = r^2]$

Hence, $a_6 = ar^5 = (4)(2)^5 = 4 \times 32 = 128.$

**34. (c)** Let $a$ be the first term and $r$ the common ratio. Then,

$\because$ 4th term = 24 $\Rightarrow ar^3 = 24$ ...(1)

and, 8th term = 384 $\Rightarrow ar^7 = 384$ ...(2)

Dividing (2) by (1), we get

$$\frac{ar^7}{ar^3} = \frac{384}{24} \Rightarrow r^4 = 16 = (2)^4 \Rightarrow r = 2$$

Substituting $r = 2$ in (i), we get

$a(2)^3 = 24 \Rightarrow a = 24 \div 8 = 3$

Hence, first term = 3 and common ratio = 2.

**35. (b)** Let, $r$ be the common ratio of G.P.

First term, $a = 1$

Now, $a_3 = ar^2 = r^2$ $(\because \quad a = 1)$

and, $a_5 = ar^4 = r^4$ But $a_3 + a_5 = 90$

$\Rightarrow r^2 + r^4 = 90 \Rightarrow r^4 + r^2 - 90 = 0$

$\Rightarrow (r^2 + 10)(r^2 - 9) = 0$

$\therefore \quad r^2 - 9 = 0$ $[\because \quad r^2 + 10 \neq 0]$

$\therefore \quad r = \pm 3.$

**36. (d)** $\frac{-2}{7}, x, \frac{-7}{2}$, are in G.P.

$$\Rightarrow \frac{x}{-2/7} = \frac{-7/2}{x} \Rightarrow x^2 = \frac{-7}{2} \times \frac{-2}{7}$$

$\therefore \quad x^2 = 1 \Rightarrow x = +1.$

**37. (b)** We have 2, 4, 8, ... 10 terms which are in G.P.

Here, $a = 2$, $r = 2$

$\therefore \quad a_n = ar^{n-1}$

$\Rightarrow a_{10} = 2(2)^{10-1} = 2^{10} = 1024.$

Hence, the number of ancestors the person has up to 10th generation = 1024.

**38. (d)** Here, $a = 7$, $l = a_n = 448$, $S_n = 889$

Let, $r$ be the common ratio

$$S_n = \frac{a(1-r^n)}{1-r} = \frac{a-lr}{1-r}$$

$$\therefore \quad 889 = \frac{7-448r}{1-r} \Rightarrow 889 - 889r = 7 - 448r$$

$$\Rightarrow 889 - 7 = 889r - 448r$$

$$\Rightarrow 882 = 441r \Rightarrow r = 2.$$

**39. (c)** Here, $\frac{S_3}{S_6} = \frac{125}{152}, \frac{a(r^3-1)(r-1)}{a(r^6-1)(r-1)} = \frac{125}{152}$

$$\Rightarrow \frac{r^3-1}{r^6-1} = \frac{125}{152}, \quad \therefore \quad \frac{r^3-1}{(r^3-1)(r^3+1)} = \frac{125}{152}$$

$$\Rightarrow \frac{1}{r^3+1} = \frac{125}{152}, \quad \therefore \quad 152 = 125r^3 + 125$$

$\Rightarrow\ 125r^3 = 27,\ \ \Rightarrow\ \ r^3 = \dfrac{27}{125}$.

or, $r^3 = \left(\dfrac{3}{5}\right)^3,\ \ \therefore\ \ r = \dfrac{3}{5}$.

Hence, the common ratio of G.P. is $\dfrac{3}{5}$.

**40.** **(a)** $(2 + 3^1) + (2 + 3^2) + (2 + 3^3) + \cdots + (2 + 3^{11})$
$= (2 + 2 + 2 + \cdots$ up to 11 terms$)$
$+ (3 + 3^2 + 3^3 + \cdots$ up to 11 terms$)$

$= 11 \times 2 + \dfrac{3(3^{11}-1)}{3-1} = 22 + \dfrac{3}{2}\ (3^{11} - 1).$

**41.** **(b)** Let, $a$ be the first term and $r$ the common ratio of G.P.

Given: $a_1 + a_2 = 36 \Rightarrow a + a\,r = 36$
$\Rightarrow a\,(1 + r) = 36$ ...(1)

Also, $a_1\,a_3 = 9a_2 \Rightarrow a\,ar^2 = 9 \times ar$
$\Rightarrow ar = 9$ ...(2)

Subtracting (2) from (1), $a = 27$

From (2), $27\,r = 9 \Rightarrow r = \dfrac{1}{3}$

$$\therefore\ S_8 = \frac{27\left[1-\left(\frac{1}{3}\right)^8\right]}{1-1/3} = \frac{3\times 27}{2}\left(1-\frac{1}{6561}\right)$$

$$= \frac{81}{2}\times\frac{6560}{6561} = \frac{3280}{81}.$$

**42.** **(b)** $S_\infty = \dfrac{a}{1-r} \Rightarrow \dfrac{80}{9} = \dfrac{a}{1-\left(\frac{-4}{5}\right)} \Rightarrow \dfrac{80}{9} = \dfrac{a}{a/5}$

$$\Rightarrow a = \frac{80}{9}\times\frac{9}{5} = 16$$

Hence, the first term is 16.

**43.** **(c)** $\left(\dfrac{3}{4}+\dfrac{3}{4^3}+\dfrac{3}{4^5}+\ldots\text{ to }\infty\right)-\left(\dfrac{5}{4^2}+\dfrac{5}{4^4}+\dfrac{5}{4^6}+\cdots\text{ to }\infty\right)$

$$= \frac{\frac{3}{4}}{1-\left(\frac{1}{4}\right)^2} - \frac{\frac{5}{4}^2}{1-\left(\frac{1}{4}\right)^2}$$

$$= \frac{3}{4}\times\frac{16}{15}-\frac{5}{16}\times\frac{16}{15} = \frac{4}{5}-\frac{1}{3} = \frac{12-5}{15} = \frac{7}{15}.$$

**44.** **(b)** $(32)\ (32)^{1/6}\ (32)^{1/36} \cdots \infty$

$$= (32)^{1+\frac{1}{6}+\frac{1}{36}+\ldots+\infty} = (32)^x,$$

where $x = 1+\dfrac{1}{6}+\dfrac{1}{36}+\cdots\infty = \dfrac{a}{1-r}$

$$= \frac{1}{1-\frac{1}{6}} = \frac{6}{5}$$

$\therefore$ Product $= (32)^x = (32)^{6/5} = (2^5)^{6/5} = 2^6 = 64.$

**45.** **(b)** The given sequence is 6,4,3, ... which is a H.P. The sequence of reciprocals of its terms is

$$\frac{1}{6},\frac{1}{4},\frac{1}{3}\ \ldots \text{ which is an A.P.}$$

Here, $a = \dfrac{1}{6}$, $d = \dfrac{1}{4} - \dfrac{1}{6} = \dfrac{1}{12}$

$\therefore\ a_9$ of A.P. $= a + 8d$

$$= \frac{1}{6}+8\times\frac{1}{12} = \frac{1}{6}+\frac{4}{6} = \frac{5}{6}$$

$\therefore$ 9th term of H.P. is $\dfrac{6}{5}$.

**46.** **(a)** First term of H.P. = 6 and second term of H.P. = 3

$\therefore$ First and second terms of corresponding A.P. are $\dfrac{1}{6}$ and $\dfrac{1}{3}$.

$\therefore\ a = \dfrac{1}{6}$ and $d = \dfrac{1}{3} - \dfrac{1}{6} = \dfrac{1}{6}$

$n$th term of A.P. $= \dfrac{1}{6} + (n-1)\ \dfrac{1}{6}$

$$= \frac{1+n-1}{6} = \frac{n}{6}$$

Hence, $n$th term of H.P. $= \dfrac{n}{6}$.

**47.** **(b)** $\because$ $x, y, z$ are in G.P.

$\therefore\ y^2 = xz$

Taking log on both sides

$2 \log y = \log x + \log z$

$\Rightarrow\ 2 + 2 \log y = (1 + \log x) + (1 + \log z)$

$\Rightarrow\ 2\,(1 + \log y) = (1 + \log x) + (1 + \log z)$

$\Rightarrow\ 1 + \log x,\ 1 + \log y,\ 1 + \log z$, are in A.P.

$\Rightarrow\ \dfrac{1}{1+\log x},\dfrac{1}{1+\log y},\dfrac{1}{1+\log z}$ are in H.P.

**48.** **(c)** $\dfrac{2}{5}+\dfrac{3}{5^2}+\dfrac{2}{5^3}+\dfrac{3}{5^4} + \cdots\infty$

$$= \left(\frac{2}{5}+\frac{2}{5^3}+\frac{2}{5^5}+\cdots\infty\right)+\left(\frac{3}{5^2}+\frac{3}{5^4}+\cdots\infty\right)$$

$$= \frac{2/5}{1-\frac{1}{5^2}}+\frac{3/5^2}{1-\frac{1}{5^2}} = \frac{25}{24}\left(\frac{2}{5}+\frac{3}{25}\right)$$

$$= \frac{25}{24}\times\frac{13}{25} = \frac{13}{24}.$$

**49.** **(c)** $a = 729$. Let, $r$ be the common ratio

Now, $a_7 = 64 \Rightarrow ar^6 = 64 \Rightarrow 729 \times r^6 = 64$

$$\therefore \quad r^6 = \frac{64}{729} = \left(\frac{2}{3}\right)^6 \quad \therefore \quad r = \frac{2}{3}$$

$$\therefore \quad S_7 = \frac{a(1-r^7)}{1-r} = \frac{729\left[1-\left(\frac{2}{3}\right)^7\right]}{1-2/3} = \frac{3\times 729}{1}\left[1-\frac{128}{2187}\right]$$

$$= 2187 \times \frac{2059}{2187} = 2059.$$

**50.** **(a)** If $r$ is the common ratio of G.P., then

$l = a\, r^{n-1}$ ...(1)

The first $n$ terms of the G.P. are

$a, ar, ar^2, ar^3, ..., ar^{n-1}$

$P = a \times ar \times ar^2 \times ar^3 \times ... \times ar^{n-1}$

$= a^n \times r^{1+2+3+\cdots+(n-1)}$

$= a^n \times r^{(n-1)\times\frac{n}{2}} = (a^2)^{n/2} \times (r^{n-1})^{n/2}$

$= (a^2\, r^{n-1})^{n/2} = (a.\, ar^{n-1})^{n/2} = (al)^{n/2}$.

## Exercise-2
## (Based on Memory)

**1.** **(c)** $S_n = \frac{n}{2}(a_1 + a_n) = \frac{15}{2}(5+19) = \frac{15}{2}\times 24 = 180$

**2.** **(a)** Required sum is

$2^2(1^2 + 2^2 + 3^2 + \cdots + 20^2)$

$= 4 \times 2870$

$= 11480$

**3.** **(c)** The given series is an A.P.

$n$th term of A.P. $= a_n = a + (n-1)\, d$

where $a$ = 1st term, $d$ = common difference

So, $72 + (n-1)(-9) = 0$

or, $72 - 9n + 9 = 0 \Rightarrow 9n = 81 \Rightarrow n = 9$.

**5.** **(b)** Let, the first term of the A.P. be $a$ and the common difference be $d$

According to question,

$a + 3d = 14$ ...(1)

and, $a + 11d = 70$ ...(2)

On solving (1) and (2), we get

$d = 7, a = -7$.

**6.** **(d)** $14^2 + 15^2 + \cdots + 30^2$

$= (1^2 + 2^2 + 3^2 + \cdots + 30^2) - (1^2 + 2^2 + \cdots + 13^2)$

$$= \frac{30(30+1)(2\text{x } 30+1)}{6} - \frac{13(13+1)(2\text{x } 13+1)}{6}$$

$$= \frac{30\times 31\times 61}{6} - \frac{13\times 14\times 27}{6} = 8636.$$

**7.** **(b)** $4 + 32 + 108 + \cdots + 4000$

$= 4\,(1 + 8 + 27 + \cdots + 1000)$

$= 4\,(1^3 + 2^3 + 3^3 + \cdots + 10^3)$

$= 4 \times 3025 = 12100.$

**8.** **(a)** $3^2 + 6^2 + 9^2 + \cdots + 30^2$

$= 3^2[1^2 + 2^2 + 3^2 + \cdots + 10^2]$

$= 9 \times 385 = 3465.$

**9.** **(a)** $(1^2 + 2^2 + 3^2 + \cdots + 19^2) - (2^2 + 4^2 + 6^2 + \cdots + 18^2)$

$$= \frac{19\times 20\times 39}{6} - 2^2(1^2 + 2^2 + 3^2 + \cdots + 9^2)$$

$$= \frac{19\times 20\times 39}{6} - 2^2 \times \frac{9\times 10\times 19}{6}$$

$$= \frac{19\times 20\times 39 - 4\times 9\times 10\times 19}{6}$$

$$= \frac{14820 - 6840}{6} = 1330.$$

**10.** **(b)** $1^3 + 2^3 + 3^3 + ... + 9^3 = 2025.$

Now, $(0.11)^3 + (0.22)^3 + (0.33)^3 + ... + (0.99)^3$

$= (0.11)^3\,[1^3 + 2^3 + 3^3 + ... + 9^3]$

$= (0.11)^3 \times 2025.$

$= 2025 \times 0.001331 = 2.695.$

**11.** **(c)** $\log 2, \log(2x - 1)$,

$\log(2x + 3)$ are in A.P.

$\Rightarrow 2[\log(2^x - 1)] = \log 2 + \log(2^x + 3)$

$= \log[2 \times (2^x + 3)]$

$\Rightarrow \log(2^x - 1)^2 = \log[2^{x+1} + 6)]$

$\Rightarrow (2^x - 1)^2 = 2^{x+1} + 6 = 2^x \times 2 + 6$

Let $2^x = y$

$(y - 1)^2 = 2y + 6$

$\Rightarrow y^2 - 2y + 1 = 2y + 6$

$\Rightarrow y^2 - 4y - 5 = 0$

$\Rightarrow \quad (y-5)(y+1) = 0$

$\Rightarrow \quad y = 5, -1.$

If $y = 5 \quad \Rightarrow \quad 2x = 5$

$\Rightarrow \quad x\log 2 = \log 5$

$\Rightarrow \quad x = \dfrac{\log 5}{\log 2} \quad \Rightarrow \quad x = \log_2 5.$

**12.** **(b)** $1^2 + 2^2 + 3^2 \cdots x^2 = x\dfrac{(x+1)(2x+1)}{6}$

$$1^2 + 2^2 + 3^2 \cdots 10^2 = 10\frac{(10+1)(20+1)}{6}$$

$$= \frac{10\times 11\times 21}{6} = \frac{2310}{6} = 385$$

**13.** **(a)** $1 + 0.6 + 0.06 + 0.006 + \cdots$

$= 1 +$ G.P. with a = 0.6 and

$$r = \frac{1}{10} = 1 + \frac{0.6}{1-\frac{1}{10}}$$

$$= 1+\frac{0.6}{0.9} = 1\frac{2}{3}$$

**14.** **(c)** The sequence is

+3, +5, +7, +9, + 11 ...

7th term = 35 + 13 = 48

8th term = 48 + 15 = 63

9th term = 63 + 17 = 80

**15.** **(c)** Sum of all multiples of 3 up to 50

$$= 3+6+\cdots+48$$
$$= 3(1+2+3+\cdots+16)$$
$$= \frac{3\times 16(16+1)}{2} = 3\times 8\times 17 = 408$$
$$\left[\because \quad 1+2+3+\cdots+n = \frac{n(n+1)}{2}\right]$$

**16.** **(b)** $\left(1-\dfrac{1}{n+1}\right)+\left(1-\dfrac{2}{n+1}\right)+\left(1-\dfrac{3}{n+1}\right)+\cdots\left(1-\dfrac{n}{n+1}\right)$

$$= n-\left(\frac{1}{n+1}+\frac{2}{n+1}+\frac{3}{n+1}+\cdots+\frac{n}{n+1}\right)$$
$$= n-\frac{1+2+3+\cdots+n}{n+1}$$
$$= n-\frac{n(n+1)}{2(n+1)} = n-\frac{n}{2} = \frac{n}{2}$$

**17.** **(b)** Required answer = $2(1 + 2 + 3 + \cdots + 12)$

$$= 2\times\frac{12\times 13}{2} = 156.$$

**18.** **(d)** $a$, 1, $b$ are in AP.

$$\therefore\ 1 = \frac{a+b}{2}$$

$\Rightarrow \quad a + b = 2 \qquad \ldots(1)$

Again, 1, $a$, $b$ are in GP.

$\therefore \quad a^2 = b \qquad \ldots(2)$

Now, putting the value of $b$ from equation (2) in equation (1), we have

$a + a^2 = 2$

$\Rightarrow \quad a^2 + a - 2 = 0$

$\Rightarrow \quad a^2 + 2a - a - 2 = 0$

$\Rightarrow \quad a(a+2) - 1\,(a+2) = 0$

$\Rightarrow \quad (a-1)(a+2) = 0 \quad \Rightarrow \quad a = -2, 1$

$\therefore \quad b = 4.$

**19.** **(a)** $\because \quad 1^2+2^2+3^2+\cdots+n^2 = \dfrac{n(n+1)(2n+1)}{6}$

$\therefore \quad 11^2 + 12^2 + \cdots + 21^2$

$$= (1^2 + 2^2 + 3^2 + \cdots + 21^2) - (1^2 + 2^2 + \cdots + 10^2)$$
$$= \frac{21(21+1)(42+1)}{6} - \frac{10\times 11\times 21}{6}$$
$$= \frac{21\times 22\times 43}{6} - \frac{10\times 11\times 21}{6}$$
$$= 3311 - 385 = 2926$$

**20.** **(b)** $\because \dfrac{1}{1\times 2} = \dfrac{1}{1}-\dfrac{1}{2}$

$$\frac{1}{2\times 3} = \frac{1}{2}-\frac{1}{3}$$
$$\frac{1}{3\times 4} = \frac{1}{3}-\frac{1}{4}$$
$$\frac{1}{4\times 5} = \frac{1}{4}-\frac{1}{5}$$

$\therefore \quad$ Given expression

$$= \left[\frac{1}{1\times 2}+\frac{1}{2\times 3}+\cdots+\frac{1}{99\times 100}\right]$$
$$= \left[\begin{array}{l}\left(\frac{1}{1}-\frac{1}{2}\right)+\left(\frac{1}{2}-\frac{1}{3}\right)+\left(\frac{1}{3}-\frac{1}{4}\right)+\cdots \\ +\left(\frac{1}{98}-\frac{1}{99}\right)+\left(\frac{1}{99}-\frac{1}{100}\right)\end{array}\right]$$
$$= 1-\frac{1}{100} = \frac{99}{100}$$

**21.** **(a)** Required sum $= \sum n = \dfrac{n(n+1)}{2}$

$$= \frac{100\times 101}{2} = 50\times 101 = 5050$$

# Set Theory

# 30

## INTRODUCTION

The concept of set is fundamental in all branches of mathematics. Sets are the most basic tools of mathematics which are extensively used in developing the foundations of relations and functions, logic theory, sequences and series, geometry, probability theory, etc. In fact, these days most of the concepts and results in mathematics are expressed in the set theoretic language.

The modern theory of sets was developed by the German mathematician Georg Cantor (1845–1918AD). In this chapter, we will study some basic definitions and operations involving sets. We will also discuss the applications of sets.

## SET

We observe that in nature, varieties of objects occur in *groups*. These groups are given different names such as, a *collection* of books, a *bunch* of keys, a *herd* of cattle, an *aggregate* of points, etc., depending on the characteristic of objects they represent. In literal sense, all these works have the same meaning. (i.e., a group or a collection). In mathematical language, we call this collection of objects, a *set*. From the above examples, it can be seen that each collection has a well-defined property (characteristic) of its own.

Thus, a *set is a well-defined collection of objects*. When we say well defined, we mean that the objects follow a given rule or rules. With the help of this rule, we will be able to say whether any given object belongs to this set or not. For example, if we say that we have a collection of short students in a class, this collection is not a set as 'short students', is not well defined. However, if we say that we have a collection of students whose height is less than 5 feet, then it represents a set.

It is not necessary that a set may consist of same type of objects, For example, a book, a cup and a plate lying on a table may also form a set, their common property being that they form a collection of objects lying on the table.

**Illustration 1:** Some other examples of sets are:

(i) The set of numbers 1, 3, 5, 7, 9, 14.
(ii) The set of vowels in the alphabets of English.
(iii) The set of rivers in India.
(iv) The set of all planets.
(v) The set of points on a circle.
(vi) The set of mathematics books in your library.
(vii) The set of even positive integers (i.e., 2, 4, 6, 8, ···).
(viii) The set of multiples of 4 (i.e., 4, 8, 12, ···).
(ix) The set of factors of 12. (i.e., 1, 2, 3, 4, 6, 12).
(x) The set of integers less than zero (i.e., –1, –2, –3, ···).

### Notations

Sets are usually denoted by capital letters $A$, $B$, $C$, etc., and their elements by small letters $a$, $b$, $c$, etc.

Let, $A$ be any set of objects and let '$a$' be a member of $A$, then we write $a \in A$ and read it as '$a$ belongs to $A$' or '$a$ is an element of $A$' or '$a$ is a member of $A$'. If $a$ is not an object of $A$, then we write $a \notin A$ and read it as '$a$ does not belong to $A$' or '$a$ is not an element of $A$'.

## REPRESENTATION OF SETS

There are two ways of expressing a set. These are

1. Tabular form or roster form.
2. Set-builder form or rule method.

### Tabular Form or Roster Form

In this method, we list all the members of the set separating them by means of commas and enclosing them in curly brackets {}.

**Illustration 2:** Let, $A$ be the set consisting of the numbers 1, 3, 4 and 5, then we write $A = \{1, 3, 4, 5\}$.

***Notes:***

- The order of writing the elements of a set is immaterial. For example, {1, 3, 5}, {3, 1, 5}, {5, 3, 1} all denote the same set.

- An element of a set is not written more than once. Thus, the set $\{1, 5, 1, 3, 4, 1, 4, 5\}$ must be written as $\{1, 3, 4, 5\}$.

### Set Builder Form or Rule Method

In this method, instead of listing all elements of a set, we write the set by some special property or properties satisfied by all its elements and write it as

$A = \{x : P(x)\}$ or, $A = \{x \mid x$ has the property $P(x)\}$ and read it as "$A$ is the set of all elements $x$ such that $x$ has the property $P$". The symbol ':' or '|' stands for 'such that'.

**Illustration 3:** Let, $A$ be the set consisting of the elements 2, 3, 4, 5, 6, 7, 8, 9, 10. Then, the set $A$ can be written as $A = \{x : 2 \leq x \leq 10$ and $x$ e $N\}$.

## FINITE AND INFINITE SETS

### Finite Set

A set having no element or a definite number of elements is called a *finite set*. Thus, in a finite set, either there is nothing to be counted or the number of elements can be counted, one by one, with the counting process coming to an end.

**Illustration 4:** Each of the following sets is a finite set:

(i) $A$ = the set of prime numbers less than 10 $= \{2, 3, 5, 7\}$;
(ii) $B$ = the set of vowels in English alphabets $= \{a, e, i, o, u\}$;
(iii) $C = \{x \mid x$ is divisor of $50\}$.

### Cardinal Number of a Finite Set

The number of distinct elements in a finite set $S$ is called the *cardinal number* of $S$ and is denoted by $n(S)$.

**Illustration 5:** If $A = \{2, 4, 6, 8\}$ then $n(A) = 4$.

### Infinite Set

A set having unlimited number of elements is called an *infinite set*. Thus, in an infinite set, if the elements are counted one by one, the counting process never comes to an end.

**Illustration 6:** Each of the following sets is an infinite set:

(i) the set of all natural numbers $= \{1, 2, 3, 4, \cdots)$.
(ii) the set of all prime numbers $= \{2, 3, 5, 7, \cdots)$.
(iii) the set of all points on a given line.
(iv) the set of all lines in a given plane.
(v) $\{x \mid x \, \varepsilon \, R$ and $0 < x < 1\}$.

## EMPTY SET (OR NULL SET)

The set which contains no element is called the *empty set* or the *null set* or *void set*.

The symbol for the empty set or the null set is $\phi$. Thus, $\phi = \{\}$, since there is no element in the empty set.

The empty set is a finite set.

Since any object $x$ which is not equal to itself does not exist, the set $A = \{x : x \neq x\}$ is the empty set $\phi$.

A set which is not empty, i.e., which has at least one element is called a *non-empty* set or a *non-void* set.

**Illustration 7:**

(i) The set of natural numbers less than 1 is an empty set.
(ii) the set of odd numbers divisible by 2 is a null set.
(iii) $\{x \mid x \in Z$ and $x^2 = 2\} = \phi$, because there is no integer whose square is 2.
(iv) $\{x \mid x \in R$ and $x^2 = -1\} = \phi$, because the square of a real number is never negative.
(v) $\{x \mid x \in N, 4 < x < 5\}$ is the empty set.
(vi) $\{x \mid x \in Z, -1 < x < 0\}$ is the null set.

The empty set should not be confused with the set $\{0\}$. It is the set containing one element, namely 0.

## SINGLETON

A set containing only one element is called a *singleton*.

**Illustration 8:**

(i) The set $\{0\}$ is a singleton since it has only one element 0.
(ii) The set of even prime numbers is the set $\{2\}$ which is a singleton.
(iii) $\{x \mid x$ is an integer and $-1 < x < 1\} = \{0\}$ is a singleton.

## EQUAL SETS

Two sets $A$ and $B$ are said to be *equal* if they have the same elements and we write $A = B$. Thus, $A = B$ if every element of $A$ is an element of $B$ and every element of $B$ is an element of $A$.

In symbols, $A = B$ iff $x \in A \Rightarrow x \in B$ and $x \in B \Rightarrow x \in A$. To indicate that two sets $A$ and $B$ are not equal, we will write $A \neq B$.

**Illustration 9:**

(i) If $A = \{2, 3, 4\}$ and $B = \{x \mid 1 < x < 5, x \in N\}$ then $A = B$.
(ii) If $A$ = the set of letters in the word 'WOLF' and $B$ = the set of letters in the word 'FOLLOW' then $A = B$ as each = {W, O, L, F}, remembering that in a set the repetition of elements is meaningless and order of elements is immaterial.

## EQUIVALENT SETS

Two finite sets $A$ and $B$ are said to be *equivalent* if they have the same number of elements, i.e., if we can find a one-to-one correspondence between the elements of the two sets.

The symbol ' $\sim$ ' is used to denote equivalence. Thus, $A \sim B$ is read as "$A$ is equivalent to $B$". Two finite sets $A$ and $B$ are equivalent if $n(A) = n(B)$, i.e., if they have the same cardinal number.

Equivalent sets have the same number of elements, not necessarily the same elements. The elements in two equivalent sets may or may not be the same. Thus, equal sets are always equivalent but equivalent sets may or may not be equal.

**Illustration 10:**

(i) If $A = \{1, 2, 3\}$ and $B = \{2, 4, 6)$ then $A \sim B$.
(ii) If $A = \{a, b, c, d\}$ and $B = \{p, q, r, s\}$ then $A \sim B$.
(iii) If $A = \{3, 5, 7, 9\}$ and $B = \{9, 7, 5, 3\}$ then $A \sim B$.

Also, since $A$ and $B$ have same elements, $\therefore A = B$.

## SUBSET OF A SET

If $A$ and $B$ are any two sets, then $B$ is called a *subset* of $A$ if every element of $B$ is also an element of $A$. Symbolically, we write it as $B \subseteq A$ or $A \supseteq B$

(i) $B \subseteq A$ is read as $B$ is contained in $A$ or $B$ is a subset of.
(ii) $A \supseteq B$ is read as $A$ contains $B$ or $A$ is *super set* of $B$.

**Illustration 11:**

(i) The set $A = \{2, 4, 6\}$ is a subset of $B = \{1, 2, 3, 4, 5, 6\}$, since each number 2, 4 and 6 belonging to $A$, also belongs to $B$.
(ii) The set $A = \{1, 3, 5\}$ is not a subset of $B = \{1, 2, 3, 4\}$ since $5 \in A$ but $5 \notin B$.
(iii) The set of real numbers is a subset of the set of complex numbers. The set of rational numbers is a subset of the set of real numbers. The set of integers is a subset of the set of rational numbers. Finally, the set of natural numbers is a subset of the set of integers. Symbolically,

$$N \subseteq Z \subseteq Q \subseteq R \subseteq C.$$

***Notes:***

- If we are to prove that $A \subseteq B$, then we should prove that $x \in A \Rightarrow x \in B$. Symbolically, $A \subseteq B$ if and only if $x \in A \Rightarrow x \in B$.
- If we are to prove that $A$ $B$, then we should prove that there exists at least one element $x$ such that $x \in A$ but $x \notin B$. Symbolically, $A$ $B$ if and only if there exists $x \in A$ such that $x \notin B$.

### Proper Subsets of a Set

$A$ set $B$ is said to be a *proper subset* of the set $A$ if every element of set $B$ is an element of $A$ whereas every element of $A$ is not an element of $B$.

We write it as $B \subset A$ and read it as "$B$ is a proper subset of $A$".

Thus, $B$ is a proper subset of $A$ if every element of $B$ is an element of $A$ and there is at least one element in $A$ which is not in $B$.

**Illustration 12:**

(i) If $A = \{1, 2, 5\}$ and $B = \{1, 2, 3, 4, 5\}$. Then $A$ is a proper subset of $B$.
(ii) The set $N$ of all natural numbers is a proper subset of the set $Z$ of all integers because every natural number is an integer, i.e., $N \subset Z$ but every integer need not be a natural number, i.e., $N \neq Z$.

***Note:***
If we are to prove that $B \subset A$, then we should prove that $B \subseteq A$ and there exists an element of $A$ which is not in $B$. Symbolically, $B \subset A$ if and only if $B \subseteq A$ and there exists $x \in A$ such that $x \notin B$.

## POWER SET

Elements of a set can also be some sets. Such sets are called *set of sets*. For example, the set $\{\phi, \{1\}, \{2\}, \{3, 4\}\}$ is a set whose elements are the sets $\phi$, $\{1\}$, $\{2\}$, $\{3, 4\}$.

The set of all the subsets of a given set $A$ is called the *power set* of $A$ and is denoted by $P(A)$.

**Illustration 13:**

(i) If $A = \{a\}$, then $P(A) = \{\phi, A\}$.
(ii) If $B = \{2, 5\}$, then $P(B) = \{\phi, \{2\}, \{5\}, B\}$.
(iii) If $S = \{a, b, c\}$, then $P(S) = \{\phi, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, S\}$.

***Notes:***

- Every set is subset of itself.
- Empty set is the subset of every set.
- If a set has $n$ elements, then the number of its subsets is $2^n$.

## COMPARABLE SETS

If two sets $A$ and $B$ are such that either $A \subset B$ or $B \subset A$, then $A$ and $B$ are said to be *comparable sets*. If neither $A \subset B$ nor $B \subset A$, then $A$ and $B$ are said to be *non-comparable sets*.

**Illustration 14:**

(i) If $A = \{1, 3, 5\}$ and $B = \{1, 2, 3, 4, 5\}$, then $A$ and $B$ are comparable sets because $A \subset B$.
(ii) If $A = B$, then $A$ and $B$ are comparable sets.

## UNIVERSAL SET

If in any discussion on set theory, all the given sets are subsets of a set $U$, then the set $U$ is called the *universal set*.

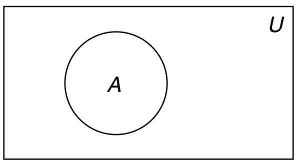
**Illustration 15:** Let, $A = \{2, 4, 6\}$, $B = \{1, 3, 5\}$, $C = \{3, 5, 7, 11\}$, $D = \{2, 4, 8, 16\}$ and $U = \{1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 16\}$ be the given sets. Here the sets $A$, $B$, $C$, $D$ are subsets of the set $U$. Hence $U$ can be taken as the *universal set*.

## VENN DIAGRAMS

In order to visualize and illustrate any property or theorem relating to universal sets, their subsets and certain operations on sets, Venn, a British mathematician developed what are called *Venn diagrams*. He represented a universal set by interior of a rectangle and other sets or subsets by interiors of circles.

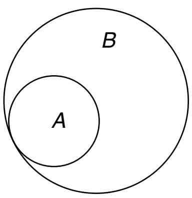
### Examples of Certain Relationships Between Sets by Venn Diagrams

**1.** If $U$ be a set of letters of English alphabets and $A$, a set of vowels, then $A \subset U$. This relationship is illustrated by Fig. ($a$).

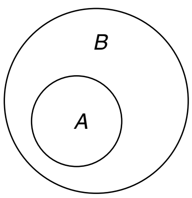



($a$)

**2.** If $A \subset B$ and $A \neq B$, then $A$ and $B$ can be represented by either of the diagrams [Figure ($b$) and Figure ($c$)].

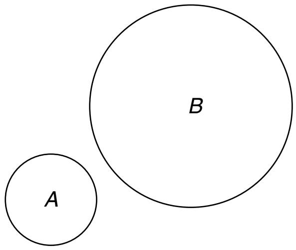



($b$)

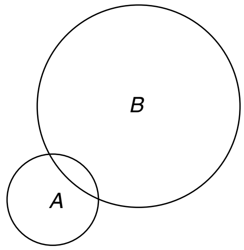



($c$)

**3.** If the sets $A$ and $B$ are not comparable, then neither of $A$ or $B$ is a subset of the other. This fact can be represented by either of the diagrams [Figure ($d$) and Figure (e)].

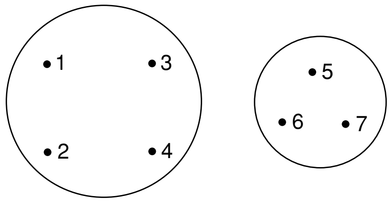



(d)




(e)

**4.** If $A = \{1, 2, 3, 4\}$ and $B = \{5, 6, 7\}$, then $A$ and $B$ are disjoint. These can be illustrated by Venn diagram given in Fig. (f).




(f)

## COMPLEMENT OF A SET

Let, $A \subset U$ (i.e., $A$ is a proper subset of universal set $U$). Evidently, $U$ consists of all the elements of $A$ together with some elements which are not in $A$. Let us now constitute another set consisting of all the elements of $U$ not in $A$. Naturally, it will form another proper subset of $U$. We call this subset *the complement of the subset A in U* and denote it by $A'$ or by $A^c$ i.e., $A^c = \{x : x \in U, x \notin A\}$.

Thus, the complement of a given set is a set which contains all those members of the universal set that do not belong to the given set.

### Illustration of $A'$ by Venn Diagram

Let, $A$ be a subset of the universal set $U$. The shaded area in figure below represents the set $A'$ which consists of those elements of $U$ which are not in $A$.

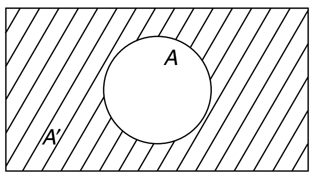



**Illustration 16:**

(i) If the universal set is $\{a, b, c, d\}$ and $A = \{a, b, d\}$ then $A' = \{c\}$.
(ii) If the universal set $U = \{1, 2, 3, 4, 5, 6\}$ and $A = \{2, 4, 6\}$, then $A' = \{1, 3, 5\}$.
(iii) If $U = N$ and $A = O$ (the set of odd natural numbers), then $A' = E$ (the set of even natural numbers).

(iv) If $U = I$, $A = N$,
then $A' = \{0, -1, -2, -3 \cdots\}$.
(v) If $U = \{1, 2, 3, 4\}$, $A = \{1, 2, 3, 4\}$,
then $A' = \phi$.

**Note:**

(i) Since $A \subset A$, we get $A' = \phi$.
(ii) $(A')' = A$, i.e., complement of the complement of a set is the set itself.

## Operations on Sets

### (a) Union of Sets

Let $A$ and $B$ be two given sets. Then the union of $A$ and $B$ is the set of all those elements which belong to either $A$ or $B$ or both.

The union of $A$ and $B$ is denoted by $A \cup B$ and is read as $A$ *union* $B$. The symbol $\cup$ stands for union. It is evident that union is 'either, or' idea. Symbolically,

$$A \cup B = \{x : \text{either } x \in A \text{ or } x \in B\}.$$

**Note:**

The union set contains all the elements of $A$ and $B$, except that the common elements of both $A$ and $B$ are exhibited only once.

## Illustration of A ∪ B by Venn Diagram

Let $A$ and $B$ be any two sets contained in a universal set $U$. Then $A \cup B$ is indicated by the shaded area in the figure below.

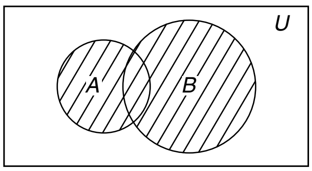



**Illustration 17:**

(i) Let, $A = \{1, 2, 3, 4\}$, $B = \{2, 3, 6, 7, 9\}$, then,
$A \cup B = \{1, 2, 3, 4, 6, 7, 9\}$.
(ii) If $A = O$ (set of odd natural numbers), $B = E$ (set of even natural numbers), then $A \cup B = N$.
(iii) If $A$ is the set of rational numbers and $B$ the set of irrational numbers, then $A \cup B = R$.
(iv) If $A = \{x : x^2 = 4, x \in I\} = \{2, -2\}$, $B = \{y : y^2 = 9, y \in I\} = \{3, -3\}$, then
$A \cup B = \{-3, -2, 2, 3\}$.
(v) If $A = \{x : 1 < x < 5, x \in N\} = \{2, 3, 4\}$, $B = \{y : 3 < y < 7, y \in N\} = \{4, 5, 6\}$, then $A \cup B = \{2, 3, 4, 5, 6\}$.

**Note:**

From the definition of the union of two sets $A$ and $B$, it is clear that

- $x \in A \cup B \Leftrightarrow x \in A$ or $x \in B$
- $x \notin A \cup B \Leftrightarrow x \notin A$ and $x \notin B$
- $A \subseteq A \cup B$ and $B \subseteq A \cup B$.

### (b) Intersection of Sets

Let $A$ and $B$ be two given sets. Then the intersection of $A$ and $B$ is the set of elements which belong to both $A$ and $B$. In other words, the intersection of $A$ and $B$ is the set of common members of $A$ and $B$.

The intersection of $A$ and $B$ is denoted by $A \cap B$ and is read as $A$ *intersection* $B$. The symbol $\cap$ stands for intersection.

It is evident that intersection is an 'and' idea. Symbolically,

$$A \cap B = \{x : x \in A \text{ and } x \in B\}.$$

**Note:**

From the definition of the intersection of two sets $A$ and $B$, it is clear that

- $x \in A \cap B \Leftrightarrow x \in A$ and $x \in B$
- $x \notin A \cap B \Leftrightarrow x \notin A$ or $x \notin B$
- $A \cap B \subseteq A$ and $A \cap B \subseteq B$.

Let $A$ and $B$ be any two sets contained in the universal set $U$. Then $A \cap B$ is indicated by the shaded area, as shown in the figure below.

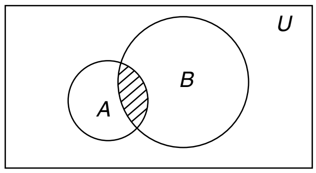


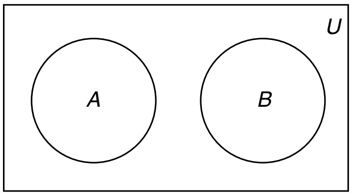

**Illustration 18:**

(i) If $A = \{1, 2, 3, 6, 9, 18\}$,
and $B = \{1, 2, 3, 4, 6, 8, 12, 24\}$,
then $A \cap B = \{1, 2, 3, 6\}$.
(ii) If $A$ is the set of odd natural numbers and $B$ is the set of even natural numbers, then $A \cap B = \phi$.
[*Intersection of two disjoint sets is empty set*]
(iii) If $A$ and $B$ are sets of points on two distinct concentric circles, then
$A \cap B = \phi$.
(iv) If $A = \{x : 1 < x < 6, x \in N\} = \{2, 3, 4, 5\}$,
$B = \{y : 2 < y < 9, y \in N\}$
$= \{3, 4, 5, 6, 7, 8\}$
then, $A \cap B = \{3, 4, 5\}$.

## Disjoint Sets

If $A \cap B = \phi$, then $A$ and $B$ are said to be *disjoint sets*. For example, let $A = \{2, 4, 6, 8\}$ and $B = \{1, 3, 5, 7\}$. Then, $A$ and $B$ are disjoint sets because there is no element

which is common to both $A$ and $B$. The disjoint sets can be represented by Venn diagram as shown in the figure below.




**(c) Difference of Sets**

Let $A$ and $B$ be two given sets. The difference of sets $A$ and $B$ is the set of elements which are in $A$ but not in $B$. It is written as $A - B$ and read as $A$ *difference* $B$. Symbolically,

$$A - B = \{x : x \in A \text{ and } x \notin B\}.$$

Similarly, $B - A = \{x : x \in B \text{ and } x \notin A\}$.

Caution: In general, $A - B \neq B - A$.

**Illustration 19:**

(i) If $A = \{1, 2, 3, 4\}$, $B = \{2, 4, 7, 9\}$, then

$$A - B = \{1, 3\} \text{ and } B - A = \{7, 9\}.$$

Hence $A - B \neq B - A$.

(ii) If $A = \{12, 15, 17, 20, 21\}$,

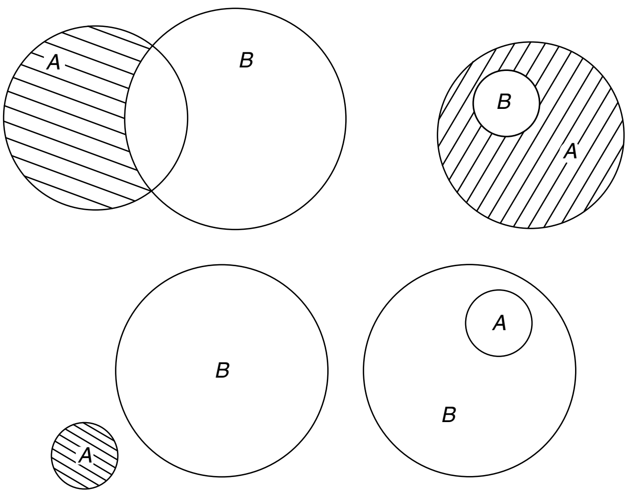
$B = \{12, 14, 16, 18, 21\}$

and $C = \{15, 17, 18, 22\}$, then

$$\begin{aligned} A - B &= \{15, 17, 20\} \\ B - C &= \{12, 14, 16, 21\} \\ C - A &= \{18, 22\} \\ B - A &= \{14, 16, 18\} \\ A - A &= \phi. \end{aligned}$$

### Illustration of A − B by Venn Diagrams

In the four cases shown by the diagrams below, $A - B$ is given by shaded area.




### Applications of Sets

1. If a set $S$ has only a finite number of elements, we denote by $n(S)$ the number of elements of $S$.

**Illustration 20:** If $U = \{1, 2, 3, 4, 5\}$, then $n(U) = 5$.

2. For any two sets $A$ and $B$, with finite number of elements, we have the following formula:

$$n(A \cup B) = n(A) + n(B) - n(A \cap B).$$

3. If $A$ and $B$ are disjoint sets, then

$$n(A \cup B) = n(A) + n(B).$$

**Illustration 21:** $X$ and $Y$ are two sets such that

$$n(X) = 17,\ n(Y) = 23,\ n(X \cup Y) = 38,$$

find $n(X \cap Y)$.

**Solution:** $n(X) = 17$, $n(Y) = 23$, $n(X \cup Y) = 38$,

$n(X \cap Y) = ?$

Now, $n(X \cup Y) = n(X) + n(Y) - n(X \cap Y)$.

Then, $38 = 17 + 23 - n(X \cap Y)$

$\Rightarrow n(X \cap Y) = 17 + 23 - 38 = 2$.

## ORDERED PAIR

Let $A$ and $B$ be two non-empty sets. If $a \in A$ and $b \in B$, an element of the form $(a, b)$ is called an *ordered pair*, where '$a$' is regarded as 'the first element' and '$b$' as the second element. It is evident from the definition that

1. $(a, b) \neq (b, a)$
2. $(a, b) = (c, d)$ if and only if $a = c$ and $b = d$.

**Equality of two ordered pairs.** Two ordered pairs $(a, b)$ and $(c, d)$ are said to be equal if and only if $a = c$ and $b = d$. The ordered pairs (2, 4) and (2, 4) are equal while the ordered pairs (2, 4) and (4, 2) are different. The distinction between the set {2, 4} and the ordered pair (2, 4) must be noted carefully. We have $\{2, 4\} = \{4, 2\}$ but $(2, 4) \neq (4, 2)$.

## CARTESIAN PRODUCT OF SETS

Let, A and $B$ be two non-empty sets. The cartesian product of $A$ and $B$ is denoted by $A \times B$ (read as '$A$ *cross* $B$') and is defined as the set of all ordered pairs $(a, b)$, where $a\ \varepsilon\ A$ and $b\ \varepsilon\ B$. Symbolically,

$$A \times B = \{(a, b) : a\ \varepsilon\ A \text{ and } b\ \varepsilon\ B\}$$

**Illustration 22:** Suppose, $A = \{2, 4, 6\}$ and $B = \{x, y\}$ Then,

$$A \times B = \{(2, x), (4, x), (6, x), (2, y), (4, y), (6, y)\}$$
$$B \times A = \{(x, 2), (x, 4), (x, 6), (y, 2), (y, 4), (y, 6)\}$$

Thus, we note that if $A \neq B$, then $A \times B \neq B \times A$.

**Illustration 23:** Let, $A = \{1, 2, 3\}$ and $B = \phi$. Then, $A \times B = \phi$, as there will be no ordered pair belonging to $A \times B$. Thus, we note that $A \times B = \phi$ if $A$ or $B$ or both of $A$ and $B$ are empty sets.

**Illustration 24:** Let, $n(A)$ represents the number of elements in set $A$. In Illustration 22, we can see that $n(A) = 3$, $n(B) = 2$ and $n(A \times B) = 6$. Thus, we note that $n(A \times B = n(A) \times n\ (B)$.

In other works, if a set $A$ has $m$ elements and a set $B$ has $n$ elements, then $A \times B$ has $mn$ elements. Further, it may be noted that $n(A \times B) = n(B \times A)$. This implies that $A \times B$ and $B \times A$ are equivalent sets.

**Illustration 25:** If there are three sets $A$, $B$, $C$ and $a \in A$, $b \in B$, $c \in C$, we form an ordered triplet $(a, b, c)$. The set of all ordered triplets $(a, b, c)$ is called the *cartesian product* of the sets $A$, $B$, $C$. That is,

$$A \times B \times C = \{(a, b, c) : a \in A, b \in B, c \in C\}.$$

## Exercise-I

**1.** Which of the following sets is non-empty?

(a) $A$ = set of odd natural numbers divisible by 2
(b) $B = \{x : x + 5 = 0, x \in N\}$
(c) $C$ = set of even prime numbers
(d) $D = \{x : 1 < x < 2, x \in N\}$,

**2.** Which of the following sets is finite?

(a) $I = \{x : x \in Z \text{ and } x^2 - 2x - 3 = 0\}$
(b) $B$ = The set of natural numbers which are divisible by 2
(c) $C$ = The set of lines passing through a point.
(d) $D = \{x : x \in Z \text{ and } x > -5\}$

**3.** Which of the following pairs of sets are not equal?

(a) $A = \{1, 3, 3, 1\}$, $B = \{1, 4\}$
(b) $A = \{x : x + 2 = 2\}$, $B = \{0\}$
(c) $A = \{1, 3, 4, 4\}$, $B = \{3, 1, 4\}$
(d) $A = \left\{1, \frac{1}{2}, \frac{1}{3}, \cdots\right\}$, $B = \left\{\frac{1}{n} : n \in N\right\}$.

**4.** Which of the following sets is empty?

(a) $A = \{x : x \in n \text{ and } x \le 1\}$
(b) $B = \{x : 3x + 1 = 0, x \in N\}$
(c) $C = \{x : x \text{ is an integer and } -1 < x < 1\}$
(d) $D$ = set of months of the year beginning with $F$.

**5.** Which of the following sets is infinite?

(a) $\{x : x$ is a prime number, $x$ is even$\}$
(b) Set of all river in India
(c) Set of all concentric circles

**6.** Which of the following sets is finite?

(a) The set of the months of a year
(b) $\{1, 2, 3, \cdots\}$
(c) $\{1, 2, 3, \cdots 90, 100\}$
(d) The set of lines which are parallel to $x$-axis
(e) The set of numbers which are multiples of 5.

**7.** Which of the following pairs of sets are not equivalent?

(a) $A = \{2, 4, 6, 8\}$, $B = \{u, v, w, x\}$
(b) $A = \{a, b, c\}$, $B = \{\alpha, \beta, \gamma, \delta, v\}$
(c) $A = \{\}$, $B = \phi$
(d) $A = \{x : x = 2n, n \in N\}$, $B = \{x : x = 2n + 1, n \in N\}$.

**8.** Find the cardinal number of the following set: $\{x : x$ is a letter of the word 'ASSASSINATION'$\}$

(a) 4 (b) 6
(c) 8 (d) 2

**9.** Find the cardinal number of the following set $\{x : x$ is a natural number $\le 30$ and is divisible by 7 or 11$\}$

(a) 4 (b) 8
(c) 6 (d) 2

**10.** Find the cardinal number of the following set $\{x : x = 2n, n \in N, 4 \le x \le 11\}$

(a) 8 (b) 6
(c) 12 (d) 4

**11.** Which of the following sets is finite?

(a) $\{x : x \in N$ and $x$ is a prime number$\}$
(b) $\{x : x$ is a quadrilateral on a plane$\}$
(c) $\{x : x \in N \text{ and } x^2 - 25 \le 0\}$
(d) $\{x : x \in N$ and $x$ is a multiple of 3$\}$.

**12.** For which of the following cases $A$ and $B$ are equivalent?

(a) $A = \{a, b, c, \cdots, z\}$, $B = \{1, 2, 3, \cdots, 24\}$
(b) $A = \left\{\frac{1}{3}, \frac{1}{2}, \frac{3}{5}\right\}$, $B = \left\{x : x = \frac{n}{n+2},\ n \in N\right\}$
(c) $A = \{2, 4, 6\}$, $B = \{(2, 4), (4, 6), (2, 6)\}$
(d) $A = \left\{x : x = \frac{n^3 - 1}{n^3 + 1}, n \in W, n \le 3\right\}$, $B = \left\{0, \frac{7}{9}, \frac{13}{14}\right\}$.

**13.** In which of the following cases, $A = B$?

(a) $A = \{12, 14, 16\}$, $B = \{16, 18, 20\}$
(b) $A = \phi$, $b = \{\}$
(c) $A = \{x : x \in \text{W and } x < 1\}$, $B = \phi$
(d) $A = \{x : x$ is a day of the week beginning with $S\}$, $B = \{\text{Sunday}\}$.

**14.** In a class, 50 students play cricket, 20 students play football and 10 play both cricket and football. How many play at least one of these two games?

(a) 60 (b) 45
(c) 55 (d) 65

**15.** Write down the power set of the set $\{0\}$.

(a) $\phi$ (b) $\{0\}$
(c) $\{\phi\}$ (d) $\{\phi, \{0\}\}$

**16.** Find the power set of $A = \{\{a, b\}, c\}$.

(a) $\{\phi, \{a, b\}, \{c\}\}$
(b) $\{A, \{a, b\}, \{c\}\}$
(c) $\{\phi, A, \{a, b\}, \{c\}\}$
(d) None of these

**17.** Which of the following pairs of sets are comparable?

(a) $A = \{1, 3, 5\}$, and $B = \{3, 2, 5, 6\}$
(b) $A = \{x : x \in N \text{ and } x \le 10\}$ and $B = \{1, 2, 3, \cdots, 10, 11\}$
(c) $A = \{1, 2, 3, \{4, 5\}\}$, and $B = \{1, 2, 3, 4, 5\}$.
(d) None of these

**18.** Let $A = \{\phi, \{\phi\}, 1, \{1, \phi\}, 7\}$. Which of the following is false?

(a) $\phi \in A$ (b) $\{\phi\} \in A$
(c) $\{1\} \in A$ (d) $\{7, \phi,\} \subset A$

**19.** Let $A = \{1, 2, \{3, 4\}, 5\}$. Which of the following statements is true?

(a) $\{3, 4\} \subset A$ (b) $\{3, 4\} \in A$
(c) $1 \subset A$ (d) $\{1, 2, 5\} \in A$

**20.** Let $A = \{1, 3, 5\}$ and $B = \{x : x$ is an odd natural number $< 6\}$. Which of the following is false?

(a) $A \subset B$ (b) $B \subset A$
(c) $A = B$ (d) None of these

**21.** Let $A = \{1, 2, \{3, 4\}, 5\}$. Which of the following statements are true?

(a) $\{3, 4\} \subset A$; (b) $\{3, 4\} \in A$;
(c) $\{\{3, 4\}\} \not\subset A$; (d) $\{1, 3, 5\} \subset A$.

**22.** Write down the power set of $A = \{8, 9\}$.

(a) $\{\phi, \{8\}, \{9\}, \{8, 9\}\}$
(b) $\{\phi, \{8\}, \{9\}\}$
(c) $\{\phi, \{8\}, \{9\}, \{8, 9\}\}$
(d) None of these

**23.** Write down the power set of $C = \{1, \{2\}\}$.

(a) $\{\phi, \{1\}, \{\{2\}\}\}$
(b) $\{\phi, \{1\}, \{\{2\}\}, \{1, \{2\}\}\}$
(c) $\{\{1\}, \{\{2\}\}, \{1, \{2\}\}$
(d) None of these

**24.** If $A = \left\{x : x = \frac{n-1}{n+1}, n \in W \text{ and } n \le 10\right\}$; point out the correct statement from the following:

(a) $0 \in A$ (b) $0 \subset A$
(c) $0 \supset A$ (d) $\frac{1}{3} \notin A$

**25.** Which of the following statements is false for the sets $A$, $B$ and $C$, where:

$A = \{x | x$ is letter of the word 'BOWL'$\}$
$B = \{x | x$ is a letter of the word 'ELBOW'$\}$
$C = \{x | x$ is a letter of the word 'BELLOW'$\}$
(a) $A \subset B$
(b) $B \supset C$
(c) $B = C$
(d) $B$ is a proper subset of $C$.

**26.** Which of the following statements is true?

(a) Every subset of a finite set is finite.
(b) Every subset of an infinite set is infinite.
(c) Every subset of an infinite set is finite.
(d) A proper subset of a finite set is equivalent to the set itself.

**27.** Let $A = \{x : x \in N \wedge x$ is a multiple of $2\}$;
$B = \{x : x \in N \wedge x$ is a multiple of $5\}$;
$C = \{x : x \in N \wedge x$ is a multiple of $10\}$;
Describe the set $(A \cap B) \cap C$,
(a) $A$ (b) $B$
(c) $A \cap B$ (d) $C$

**28.** Let $A = \{x : x \in N \wedge x$ is a multiple of $2\}$
$B = \{x : x \in N \wedge x$ is a multiple of $5\}$
$C = \{x : x \in N \wedge x$ is a multiple of $10\}$
Describe the set $A \cap (B \cup C)$
(a) $A$ (b) $B$
(c) $C$ (d) None of these

**29.** If $U = \{2, 3, 4, 5, 6, 7, 8, 9, 10, 11\}$, $A = \{2, 4, 7\}$, $B = \{3, 5, 7, 9, 11\}$ and $C = \{7, 8, 9, 10, 11\}$, compute: $(A \cap U) \cap (B \cup C)$

(a) $\{7\}$ (b) $\{9\}$
(c) $\{6\}$ (d) $\{5\}$

**30.** If $U = \{a, b, c, d, e, f\}$, $A = \{a, b, c\}$, find $(U \cup A)'$.

(a) $U$ (b) $A$
(c) $\phi$ (d) None of these

**31.** If $U = \{a, b, c, d, e, f\}$, $A = \{a, b, c\}$, $B = \{c, d, e, f\}$, and $C = \{c, d, e\}$ find $(A \cup B) \cup C$.

(a) $A$ (b) $B$
(c) $C$ (d) $U$

**32.** If $U = \{a, b, c, d, e, f\}$, $A = \{a, b, c\}$, $B = \{c, d, e, f\}$, $C = \{c, d, e\}$, find $(A \cap B) \cup (A \cap C)$.

(a) $\{c\}$ (b) $\{\alpha\}$
(c) $\{b\}$ (d) $\{d\}$

**33.** Which of the following pairs of sets are disjoint?

(i) $\{1, 2, 3, 4\}$ and $\{x : x$ is a natural number and $4 \le x \le 6\}$
(ii) $\{a, e, i, o, u\}$ and $\{c, d, e, f\}$
(iii) $\{x : x$ is an even integer$\}$ and $\{x : x$ is an odd integer$\}$.

(a) (i) (b) (ii)
(c) (iii) (d) None of these

**34.** If $U = \{2, 3, 4, 5, 6, 7, 8, 9, 10, 11\}$, $A = \{3, 5, 7, 9, 11\}$ and $B = \{7, 8, 9, 10, 11\}$, Compute $(A - B)'$.

(a) $\{2, 3, 5, 7, 9, 11, 12\}$
(b) $\{2, 4, 6, 8, 10, 11, 12\}$
(c) $\{2, 4, 6, 8, 9, 10, 11\}$
(d) None of these

**35.** In a class of 100 students, the number of students passed in English only is 46, in Maths only is 46, in Commerce only is 58. The number who passed in English and Maths is 16, Maths and Commerce is 24 and English and Commerce is 26, and the number who passed in all the subjects is 7. Find the number of the students who failed in all the subjects.

(a) 9 (b) 8
(c) 10 (d) None of these

**36.** If $X$ and $Y$ are two sets such that $X \cup Y$ has 18 elements, $X$ has 8 elements, and $Y$ has 15 elements, how many elements does $X \cap Y$ have?

(a) 5 (b) 7
(c) 9 (d) 11

**37.** If $A$ and $B$ are two sets such that $A$ has 40 elements, $A \cup B$ has 60 elements and $A \cup B$ has 10 elements, how many elements does $B$ have?

(a) 40 (b) 30
(c) 45 (d) 50

**38.** If $S$ and $T$ are two sets such that $S$ has 21 elements, $T$ has 32 elements, and $S \cap T$ has 11 elements, how many elements does $S \cup T$ have?

(a) 52 (b) 32
(c) 42 (d) None of these

**39.** In a group of 1000 people, there are 750 people who can speak Hindi and 400 who can speak English. How many can speak Hindi only?

(a) 600 (b) 650
(c) 750 (d) 800

**40.** In a class of 50 students, 35 opted for mathematics and 37 opted for Biology. How many have opted for both Mathematics and Biology? How many have opted for only Mathematics? (Assume that each student has to opt for at least one of the subjects).

(a) 15 (b) 17
(c) 13 (d) 19

**41.** In a group of 70 people, 37 like coffee, 52 like tea and each person likes at least one of the two drinks. How many people like both coffee and tea?

(a) 19 (b) 17
(c) 23 (d) 21

**42.** In a town with a population of 5000, 3200 people are egg-eaters, 2500 meat eaters and 1500 eat both egg and meat. How many are pure vegetarians?

(a) 600 (b) 800
(c) 900 (d) 850

**43.** Let $A = \{1, 2\}$, $B = \{2, 3\}$. Evaluate $A \times B$.

(a) $\{(2, 1), (3, 1), (2, 3)\}$
(b) $\{(1, 2), (1, 3), (2, 3)\}$
(c) $\{(1, 2), (1, 3), (2, 2), (2, 3)\}$
(d) None of these

**44.** If $A = \{a, b\}$, $B = \{2, 3, 5, 6, 7\}$ and $C = \{5, 6, 7, 8, 9\}$, find $A \times (B \cap C)$.

(a) $A$ (b) $\phi$
(c) $\{(5, a), (6, a), (7, a), (5, b), (6, b), (7, b)\}$
(d) $\{(a, 5), (a, 6), (a, 7), (b, 5), (b, 6), (b, 7)\}$

**45.** If $A = \{a, d\}$, $B = \{b, c, e\}$ and $C = \{b, c, f\}$, then $A \times (B \cup C) =$

(a) $\phi$
(b) $(A \times B) \cap (A \times C)$
(c) $(A \times B) \cup (A \times C)$
(d) None of these

**46.** If $A = \{a, d\}$, $B = \{b, c, e\}$ and $C = \{b, c, f\}$, then $A \times (B \cap C) =$

(a) $\phi$
(b) $(A \times B) \cap (A \times C)$
(c) $(A \times B) \cup (A \times C)$
(d) None of these

**47.** If $A = \{a, d\}$, $B = \{b, c, e\}$ and $C = \{b, c, f\}$, then $A \times (B - C) =$

(a) $(A \times B) - (A \times C)$ (b) $(A \times B)$
(c) $A \times C$ (d) None of these

**48.** If $A = \{1, 2, 3\}$, $B = \{2, 3, 4\}$, $C = \{1, 3, 4\}$ and $D = \{2, 4, 5\}$, then $(A \times B) \cap (C \times D) =$

(a) $(A \cap D) \times (B \cap C)$
(b) $(A \cap C) \times (B \cap D)$
(c) $\phi$
(d) None of these

**49.** The catresian product $A \times A$ has 9 elements and two of them are $(-1, 0)$ and $(0, 1)$. Find the set $A$?

(a) $A = \{0, 1\}$ (b) $A = \{-1, 0, 1\}$
(c) $A = \{0, -1\}$ (d) $A = \{1, -1,\}$

**50.** If $A$ and $B$ have $n$ elements in common, how many elements do $A \times B$ and $B \times A$ have in common?

(a) $n$ (b) $n^3$
(c) $n^2$ (d) None of these

## Exercise-2
## (Based on Memory)

**1.** In an examination, 40% students failed in Hindi, 50% students failed in English. If 21% students failed in both the subjects, find the percentage of those who passed in Hindi.

(a) 31% (b) 40%
(c) 55% (d) 60%

**[UPPCS, 2012]**

**2.** In a group of 50 people, 35 speak Hindi, 25 speak both Hindi and English and all the people speak Hindi or English or both. The number of people who speak English only is:

(a) 40 (b) 20
(c) 15 (d) 10

**[UPPCS, 2012]**

**3.** In a certain office, 72% of the workers prefer cold drink and 44% prefer tea. If each of them prefers cold drink or tea and 40 like both, then the total number of workers in the office is:

(a) 40 (b) 240
(c) 220 (d) 210

**[UPPCS, 2012]**

**4.** In a survey of a town, it was found that 65% of the people surveyed watch the news on T.V. 40% read a newspaper and 25% read a newspaper and watch the news on T.V. What per cent of the people surveyed neither watch the news on T.V. nor read a newspaper?

(a) 5% (b) 10%
(c) 20% (d) 15%

**[SSC (GL), 2011]**

**5.** There are 80 families in a small extension area. 20 per cent of these families own a car each. 50 per cent of the remaining families own a motor cycle each. How many families in that extension do not own any vehicle?

(a) 30 (b) 32
(c) 23 (d) 36

**[SSC (GL), 2011]**

**6.** Out of 100 families in the neighbourhood, 50 have radios, 75 have TVs and 25 have VCRs. Only 10 families have all three and each VCR owner also has a TV. If some families have radio only, how many have only TV?

(a) 30 (b) 35
(c) 40 (d) 45

**[SSC (GL), 2011]**

**7.** If the number of items in a set $A$ is $n(A) = 40$. If $n(B) = 26$ and $n(A \cap B) = 16$ then $n(A \cap B)$ is equal to:

(a) 30 (b) 40
(c) 50 (d) 60

**[SSC, 2014]**

**8.** $\sqrt{64009}$ is equal to:

(a) 352 (b) 523
(c) 253 (d) 532

**[SSC, 2014]**

**9.** 72% of the students of a certain class took Biology and 44% took Mathematics. If each student took at least one of Biology or Mathematics and 40 students took both of these subjects, the total number of students in the class is:

(a) 200 (b) 240
(c) 250 (d) 320

**[SSC, 2010]**

**10.** In an examination, 30% of the total students failed in Hindi, 45% failed in English and 20% failed in both the subjects. Find the percentage of those who passed in both the subjects.

(a) 35.7% (b) 35%
(c) 40% (d) 45%
(e) 44%

**[IBPS PO/MT, 2013]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (a) | **3.** (a) | **4.** (b) | **5.** (c) | **6.** (a) | **7.** (b) | **8.** (b) | **9.** (c) | **10.** (d) | **11.** (c) | **12.** (c) | **13.** (b) |
| **14.** (a) | **15.** (d) | **16.** (c) | **17.** (b) | **18.** (c) | **19.** (b) | **20.** (d) | **21.** (b) | **22.** (a) | **23.** (b) | **24.** (a) | **25.** (d) | **26.** (a) |
| **27.** (d) | **28.** (c) | **29.** (a) | **30.** (c) | **31.** (d) | **32.** (a) | **33.** (c) | **34.** (d) | **35.** (a) | **36.** (a) | **37.** (b) | **38.** (c) | **39.** (a) |
| **40.** (c) | **41.** (a) | **42.** (b) | **43.** (c) | **44.** (d) | **45.** (c) | **46.** (b) | **47.** (a) | **48.** (b) | **49.** (b) | **50.** (c) | | |

### Exercise-2

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** (d) | **2.** (c) | **3.** (a) | **4.** (c) | **5.** (b) | **6.** (b) | **7.** (c) | **8.** (c) | **9.** (c) | **10.** (d) |

# EXPLANATORY ANSWERS

## Exercise-1

**1.** **(c)** (a) As no odd natural number is divisible by 2, the set $A$ is empty.

(b) Since no natural number satisfies the equation $x + 5 = 0$, $\therefore\ B = \phi$.

(c) Since 2 is an even prime number, i.e., $C = \{2\}$, $C$ is not an empty set.

(d) Since there is no natural number between 1 and 2, $D$ is an empty set.

**2.** **(a)** (a) $A = \{x : x \varepsilon Z \text{ and } x^2 - 2x - 3 = 0\} = \{3, -1\}$. $\therefore\ A$ is a finite set.

(b) $B$ = The set of natural numbers divisible by 2 = $\{2, 4, 6, 8, 10, \cdots\}$. $\therefore\ B$ is an infinite set.

(c) Since infinite number of lines pass through a point, $C$ is an infinite set.

(d) $D = \{-4, -3, -2, \cdots\}$. Clearly $D$ is an infinite set.

**3.** **(a)** (a) $A = \{1, 3\}$; $B = \{1, 4\}$. $A$ and $B$ have different elements, $\therefore\ A \neq B$.

(b) $A = \{x : x + 2 = 2\} = \{0\}$; $B = \{0\}$. $A$ and $B$ have same elements, $\therefore\ A = B$.

(c) $A = \{1, 3, 4, 4\} = \{1, 3, 4\}$; $B = \{3, 1, 4\}$. $A$ and $B$ have same elements, $\therefore\ A = B$.

(d) $A = \left\{1, \frac{1}{2}, \frac{1}{3}, \cdots\right\} = \left\{\frac{1}{1}, \frac{1}{2}, \frac{1}{3}, \cdots\right\}$;

$B = \left\{\frac{1}{n} : n \in N\right\} = \left\{\frac{1}{1}, \frac{1}{2}, \frac{1}{3}, \cdots\right\}$.

$A$ and $B$ have same elements, $\therefore\ A = B$.

**14.** **(a)** Given: $n(C) = 50$, $n(F) = 20$, $n(C \cup F) = 10$.

Number of students playing at least one of these two games $= n\,(C \cup F) = n\,(C) + n\,(F) - n\,(C \cap F)$

$= 50 + 20 - 10 = 60$.

**15.** **(d)** Let, $A = \{0\}$. The possible subsets of this set $A$ are $\phi$ and $\{0\}$, so the power set of the given set $A$ is $P(A) = \{f, \{0\}\}$.

**16.** **(c)** Let, $A = \{\{a, b\}, c\}$. To determine $P(A)$: Since $A$ contains two elements $\{a, b\}$, $c$, $P(A)$ will contain $2^2 = 4$ elements.

The elements of $P(A)$ are $\phi$, $A$, $\{a, b\}$, $\{c\}$.

**17.** **(b)** (a) $1 \in A$ but $1 \notin B$ and $6 \in B$ but $6 \notin A$.

$\therefore$ $A$ and $B$ are not comparable.

(b) $A = \{x : x \in N \text{ and } x \le 10\} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ $B = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11\}$ Clearly, $A \subset B \Rightarrow A$ and $B$ are comparable.

(c) $\{4, 5\} \in A$ but $\{4, 5\} \notin B$ and $4 \in B$ but $4 \notin A$.

$\therefore$ $A$ and $B$ are not comparable.

**27.** **(d)** $A = \{2, 4, 6, \cdots\}$

$B = \{5, 10, 15, \cdots\}$

$C = \{10, 20, 30, \cdots\}$

$\therefore\ (A \cap B) = \{2, 4, 6 \cdots\} \cap \{5, 10, 15, \cdots\}$

$= \{10, 20, 30, \cdots\} = C$

$\therefore\ (A \cap B) \cap C = C \cap C = C$.

**28.** **(c)** $B \cup C = \{5, 10, 15, \cdots\} \cup \{10, 20, 30, \ldots\}$

$= \{5, 10, 15, \cdots\}$

$\therefore\ A \cap (B \cap C) = \{2, 4, 6, \cdots\} \cap \{5, 10, 15, \cdots\}$

$= \{10, 20, 20, \cdots\} = C$.

**29.** **(a)** $A \cap U = \{2, 4, 7\}$; $B \cup C = \{3, 5, 7, 8, 9, 10, 11\}$. Then $(A \cap U) \cap (B \cup C) = \{2, 4, 7,\} \cap \{3, 5, 7, 8, 9, 10, 11\} = \{7\}$.

**30.** **(c)** $U \cup A = \{a, b, c, d, e, f\} \cup \{a, b, c\}$

$= \{a, b, c, d, e, f\} = U$

$(U \cup A)' = \phi$.

**31.** **(d)** $A \cup B = \{a, b, c\} \cup \{c, d, e, f\}$

$= \{a, b, c, d, e, f\}$

$\therefore \quad (A \cup B) \cup C = \{a, b, c, d, e, f\} \cup \{c, d, e\}$
$= \{a, b, c, d, e, f\}$
$= U.$

**32.** **(a)** $A \cap B = \{a, b, c\} \cap \{c, d, e, f\} = \{c\}$
$A \cap C = \{a, b, c\} \cap \{c, d, e\} = \{c\}$
$\therefore \quad (A \cap B) \cup (A \cap C) = \{c\}.$

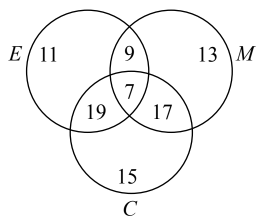
**33.** **(c)** (a) $\{x : x$ is a natural number and $4 \le x \le 6\}$ $= \{4, 5, 6\}$. Now , $\{1, 2, 3, 4\}$ and $\{4, 5, 6\}$ have one element 4 common. Therefore, the given two sets are not disjoint.

(b) The sets $\{a, e, i, o, u\}$ and $\{c, d, e, f\}$ have one element $e$ as common. Then, the given two sets are not disjoint.

(c) The sets $\{x : x$ is an even integer$\}$ and $\{x : x$ is an odd integer$\}$ have no element as common and therefore they are disjoint sets.

**34.** **(d)** $A - B$ is a set of member which belong to $A$ but do not belong to $B$
$\therefore \quad A - B = \{3, 5\}$
$\therefore \quad (A - B)' = \{2, 4, 6, 7, 8, 9, 10, 11\}.$

**35.** **(a)**




No. of students who passed in one or more subjects = 11 + 9 + 13 + 17 + 15 + 19 + 7 = 91.

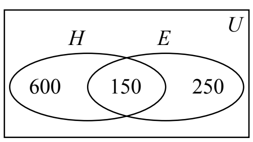
No. of students who failed in all the subjects = 100 – 91 = 9.

**36.** **(a)** We are given $n(X \cup Y) = 18$, $n(X) = 8$, $n(Y) = 15$. Using the formula
$n(X \cap Y) = n(X) + n(Y) - n(X \cup Y)$,
we get $n(X \cap Y) = 8 + 15 - 18 = 5$.

**37.** **(b)** We are given $n(A) = 40$, $n(A \cap B) = 60$ and $n(A \cap B) = 10$. Putting these values in the formula $n(A \cup B) = n(A) + n(B) - n(A \cap B)$ we get $60 = 40 + n(B) - 10 \;\Rightarrow\; n(B) = 30$.

**38.** **(c)** $n(S) = 21$, $n(T) = 32$, $n(S \cap T) = 11$, $n(S \cup T) = ?$
Using $n(S \cup T) = n(S) + n(T) - n(S \cap T)$
$= 21 + 32 - 11 = 42$
Hence, $S \cup T$ has 42 elements.

**39.** **(a)** Here, $n(H \cup E) = 1000$, $n(H) = 750$, $n(E) = 400$
Using $n(H \cup E) = n(H) + n(E) - n(H \cap E)$

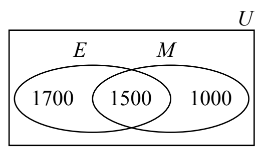



We get $1000 = 750 + 400 - n(H \cap E)$
$\Rightarrow \quad n(H \cap E) = 1150 - 1000 = 150.$
Number of People who can speak Hindi only
$= n(H \cap E') = n(H) - n(H \cap E)$
$= 750 - 150 = 600.$

**40.** **(c)** Here, $n(M \cup B) = 50$, $n(M) = 35$, $n(B) = 37$, $n(M \cap B) = ?$
Using $n(M \cup B) = n(M) + n(B) - n(M \cap B)$
We get $50 = 35 + 37 - n(M \cap B)$
$\Rightarrow \quad n(M \cap B) = 35 + 37 - 50 = 72 - 50 = 22$
$\therefore$ 22 students have opted for both Mathematics and Biology.
Again number of students who have opted for only Mathematics $= n(M) - n(M \cap B) = 35 - 22 = 13$.

**41.** **(a)** Let $A$ = set of people who like coffee and $B$ = set of people like tea.
Then, $A \cap B$ = set of people who like at least one of the tow drinks.
And $A \cap B$ = set of people who like both the drinks.
Here, $n(A) = 37$, $n(B) = 52$, $n(A \cup B) = 70$.
Using the result
$n(A \cup B) = n(A) + n(B) - n(A \cap B)$
we have $70 = 37 + 52 - n(A \cap B)$
$\Rightarrow \quad n(A \cap B) = 89 - 70 = 19.$
$\therefore$ 19 people like both coffee and tea.

**42.** **(b)** Let, $E$ be the set of people who are egg-eaters and $M$ be the set of people who are meat-eaters.
We have, $n(E) = 3200$, $n(M) = 2500$, $n(E \cap M) = 1500$.
Using $n(E \cup M) = n(E) + n(M) - n(E \cap M)$
$= 3200 + 2500 - 1500$
$= 5700 - 1500 = 4200.$




$\therefore$ Number of pure vegetarians
$n(U) - n(E \cup M)$
$5000 - 4200 = 800.$

**43.** **(c)** $A \times B = \{1, 2\} \times \{2, 3\}$
$= \{(1, 2), (1, 3), (2, 2), (2, 3)\}.$

**44.** **(d)** We have,
$(B \cap C) = \{2, 3, 5, 6, 7\} \cap \{5, 6, 7, 8, 9\}$
$= \{5, 6, 7\}$
$\therefore \quad A \times (B \cap C) = \{a, b\} \times \{5, 6, 7\}$
$= \{(a, 5), (a, 6), (a, 7), (b, 5), (b, 6), (b, 7)\}.$

**45.** **(c)**
$(B \cup C) = \{b, c, e\} \cup \{b, c, f\} = \{b, c, e, f\}$
$\therefore \quad A \times (B \cup C) = \{a, d\} \times \{b, c, e, f\}$

$= \{(a, b), (a, c), (a, e), (a, f), (d, b), (d, c), (d, e), (d, f)\}$ ...(1)

Also, $(A \times B) = \{(a, b), (a, c), (a, e), (d, b), (d, c), (d, e)\}$

and, $(A \times C) = \{(a, b), (a, c), (a, f), (d, b), (d, c), (d, f)\}$ ...(2)

$\therefore \quad (A \times B) \cup (A \times C) = \{(a, b), (a, c), (a, e), (a, f), (d, b), (d, c), (d, e), (d, f)\}$

From (1) and (2), we have

$A \times (B \cup C) = (A \times B) \cup (A \times C)$.

**46.** **(b)** $(B \cap C) = \{b, c, e\} \cap \{b, c, f\} = \{b, c\}$

$\therefore \quad A \times (B \cap C) = \{a, d\} \times \{b, c\}$

$= \{(a, b), (a, c), (d, b), (d, c)\}$

Also, $(A \times B) \cap (A \times C)$

$= \{(a, b), (a, c), (a, b), (d, c)\}$

$\therefore \quad A \times (B \cap C) = (A \times B) \cap (A \times C)$.

**47.** **(a)** $(B - C) = \{b, c, e\} - \{b, c, f\} = \{e\}$

$\therefore \quad A \times (B - C) = \{(a, e), (d, e)\}$ ...(1)

Also, $(A \times B) - (A \times C) = \{(a, e), (d, e)\}$ ...(2)

Hence, from (1) and (2), we have

$A \times (B - C) = (A \times B) - (A \times C)$.

**48.** **(b)** $(A \times B) = \{1, 2, 3\} \times \{2, 3, 4\}$

$= \{(1, 2), (1, 3), (1, 4), (2, 2), (2, 3), (2, 4), (3, 2), (3, 3), (3, 4)\}$

$(C \times D) = \{1, 3, 4\} \times \{2, 4, 5\}$

$= \{(1, 2), (1, 4), (1, 5), (3, 2), (3, 4), (3, 5), (4, 2), (4, 4), (4, 5)\}$

$\therefore \quad (A \cap B) \cap (C \times D)$

$= \{(1, 2), (1, 4), (3, 2), (3, 4)\}$

Also, $(A \cap C) = \{1, 3\}$ and $(B \cap D)$

$= \{2, 4\}$. Therefore,

$(A \cap C) \times (B \cap D) = \{(1, 2), (1, 4), (3, 2), (3, 4)\}$

Hence, $(A \times B) \cap (C \times D) = (A \cap C) \times (B \cap D)$.

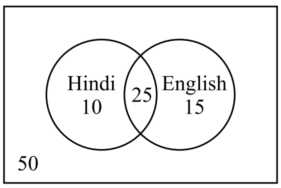
## EXERCISE-2
## (BASED ON MEMORY)

**1.** **(d)** In 40% students failed Hindi then 60% students passed in Hindi.

**2.** **(c)** Number of people speak English only

$= 50 - (10 + 25)$

$= 15$



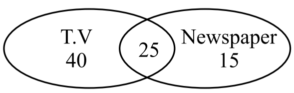

**3.** **(a)** $72\% + 44\% = 116\%$

$\because \quad 16\% \rightarrow 40$

$\therefore \quad 100\% \rightarrow \frac{40}{16} \times 100 = 250$

Hence, 16% workers are there who prefer both drinks which are 40 in number.

**4.** **(c)**




Required percentage

$= 100 - (40 + 25 + 15)$

$= 100 - 80 = 20\%$

**5.** **(b)** 20% of 80 $= \frac{20}{100} \times 80 = 16$

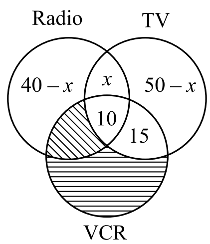
Remaining 50%

$= (80 - 16) \times \frac{50}{100} = 32$

No. of families not owning any vehicle

$= 80 - (32 + 16) = 80 - 48 = 32$

**6.** **(b)**




$\therefore \quad (40 - x) + x + 10 + 15 + (50 - x) = 100$

$\Rightarrow \quad 115 - 2x + x = 100$

$\therefore \quad x = 115 - 100 = 15$

$\therefore \quad$ Only TV $= 75 - 15 - 10 - 15 = 35$

**7.** **(c)** $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

$= 40 + 26 - 16 = 50$

**8.** **(c)**

| | | |
|---|---|---|
| 2 | 6 $\overline{40}\,\overline{09}$ | 253 |
| 2 | 4 | |
| 45 | 240 | |
| 5 | 225 | |
| 503 | 1509 | |
| 3 | 1509 | |
| 506 | × | |

$\therefore \quad \sqrt{64009} = 253$

**9.** **(c)** $n(A)$ = Biology students = 72%

$n(B)$ = Mathematics students = 44%

Total students = $n(A \cup B)$ = 100%

$\therefore \quad 100\% = 72\% + 44\% - n(A \cap B)$

$= 116\% - n(A \cap B)$

$\therefore \quad n(A \cap B) = 16\%$

$\Rightarrow$ number of students studying both subjects = 40

$\therefore$ Let the total number of students be $x$

Now, according to the question,

$$\frac{16x}{100} = 40$$

$\therefore \quad x = 250$

**10.** **(d)** Let the number of students be 100. Number of students who failed in Hindi is 30%.

$n(H) = 30$

Number of students who failed in English is 45%.

$\therefore \quad n(E) = 45$

Number of students who failed in both the subjects is 20%.

$n(H \cup E) = 20$

Applying the rule,

$n(H \cup \text{E}) = n(H) + n(E) - n(H \cap E)$

$= 30 + 45 - 20 = 55$

Percentage of students who failed in Hindi or English or both the subjects = 55%

Number of students who passed in both the subjects = $100 - 55 = 45\%$

# Permutations and Combinations 31

## INTRODUCTION

We often come across questions such as the following:

1. In how many ways can 4 bottles be arranged in a row?
2. In how many ways can 5 students be seated at a round table?
3. In how many ways can a group of five people be selected out of a gathering of ten people?
4. In how many ways can 5 maps be selected out of 8 and displayed in a row?

Answers to these questions and many other important and more difficult ones can often be given without actually writing down all the different possibilities. In the present chapter we shall study some basic principles of the art of counting without counting which will enable us to answer such questions in an elegant manner.

## FACTORIAL NOTATION

The continued product of first $n$ natural numbers is called $n$ factorial or factorial $n$ and is denoted by $\underline{|n}$ or $n!$

Thus, $\underline{|n}$ or $n!$

$= 1 \cdot 2 \cdot 3 \cdot 4 ....... (n-1)n$

$= n \cdot (n-1) \cdot (n-2) ........ 3 \cdot 2 \cdot 1$ (in reverse order)

***Notes:***

1. When $n$ is a negative integer or a fraction, $n!$ is not defined. Thus, $n!$ is defined only for positive integers.
2. According to the above definition, 0! makes no sense. However, we define $0! = 1$.
3. $n! = n(n-1)!$
4. $(2n)! = 2^n \cdot n! \, [1 \cdot 3 \cdot 5 \cdot 7 \, .......... \, (2n-1)]$.

**Illustration 1:** Evaluate

(i) $\dfrac{30!}{28!}$ (ii) $\dfrac{9!}{5!3!}$

(iii) $\dfrac{12!-10!}{9!}$ (iv) $\dfrac{1}{3!}+\dfrac{1}{4!}+\dfrac{1}{5!}$.

**Solution:**

(i) $\dfrac{30!}{28!} = \dfrac{30 \times 29 \times 28!}{28!} = 30 \times 29 = 870.$

(ii) $\dfrac{9!}{5!3!} = \dfrac{9 \times 8 \times 7 \times 6 \times 5!}{5! \times 3 \times 2} = 504.$

(iii) $\dfrac{12!-10!}{9!} = \dfrac{12 \times 11 \times 10! - 10!}{9!}$

$= \dfrac{10!}{9!}[132 - 1]$

$= 10 \times 131$

$= 1310.$

(iv) $\dfrac{1}{3!}+\dfrac{1}{4!}+\dfrac{1}{5!} = \dfrac{4 \times 5}{3! \times 4 \times 5} + \dfrac{5}{4! \times 5} + \dfrac{1}{5!}$

$= \dfrac{20}{5!}+\dfrac{5}{5!}+\dfrac{1}{5!}$

$= \dfrac{26}{5!} = \dfrac{13}{60}.$

**Illustration 2:** Convert into factorials:

(i) 4.5.6.7.8.9.10.11. (ii) 2.4.6.8.10.

**Solution:** (i) $4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 \cdot 9 \cdot 10 \cdot 11$

$= \dfrac{1.2.3.4.5.6.7.8.9.10.11}{1.2.3.}$

$= \dfrac{11!}{3!}.$

(ii) $2 \cdot 4 \cdot 6 \cdot 8 \cdot 10$

$= (2 \cdot 1) \cdot (2 \cdot 2) \cdot (2 \cdot 3) \cdot (2 \cdot 4) \cdot (2.5)$

$= (2 \cdot 2 \cdot 2 \cdot 2 \cdot 2) \cdot (1 \cdot 2 \cdot 3 \cdot 4 \cdot 5)$

$= 2^5 \cdot 5!.$

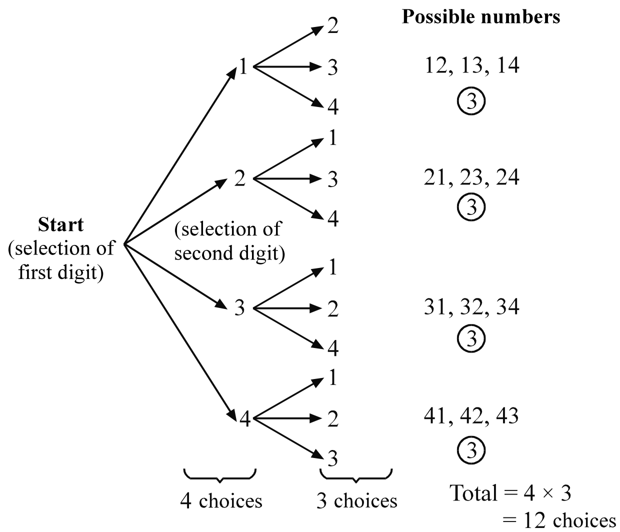
### Fundamental Principle of Counting

***Multiplication Principle*** If an operation can be performed in '$m$' different ways; following which a second operation can be performed in '$n$' different ways, then the 2 operations in succession can be performed in $m \times n$ different ways.

**Illustration 3:** How many numbers of 2 digits can be formed out of the digits 1, 2, 3, 4, no digit being repeated?

**Solution:** The first digit can be any 1 of the 4 digits 1, 2, 3, 4, that is the first digit can be chosen in 4 ways. Having chosen the first digit, we are left with 3 digits from which the second digit can be chosen. Therefore, the possible ways of choosing the two digits are

Since the first digit can be chosen in four ways and for each choice of the first digit there are three ways of choosing the second digit, therefore, there are 4 × 3




ways, that is, 12 ways of choosing both the digits. Thus, 12 numbers can be formed.

**Illustration 4:** Anu wishes to buy a birthday card for her brother Manu and send it by post. Five different types of cards are available at the card-shop, and four different types of postage stamps are available at the post-office. In how many ways can she choose the card and the stamp?

**Solution:** She can choose the card in five ways. For each choice of the card she has four choices for the stamp. Therefore, there are 5 × 4 ways, that is, 20 ways of choosing the card and the stamp.

**Illustration 5:** Mohan wishes to go from Agra to Chennai by train and return from Chennai to Delhi by air. There are six different trains from Agra to Chennai and five different flights from Chennai to Agra. In how many ways can he perform the journey?

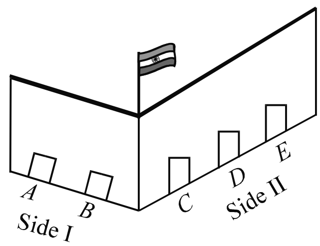
**Solution:** Since he can choose any one of the six trains for going to Chennai, and for each such choice he has five choices for returning to Agra, he can perform the journey in 6 × 5 ways, that is, 30 ways.

## Addition Principle

If an operation can be performed in '*m*' different ways and another operation, which is independent of the first operation, can be performed in '*n*' different ways, then either of the two operations can be performed in $(m + n)$ ways.

***Note:***
he above two principles can be extended for any finite number of operations.

**Illustration 6:** Suppose there are 5 gates to a stadium, 2 on one side and 3 on the other. Sohan has to go out of the stadium. he can go out from any one of the 5 gates. Thus, the number of ways in which he can go out is 5. Hence, the work of going out through the gates on one side will be done in 2 ways and the work of going out through the gates on other side will be done in 3 ways. The work of going out will be done when Sohan goes out from side I or side II. Thus the work of going out can be done in (2 + 3) = 5 ways.




***Note:***

Addition theorem of counting is also true for more than two opeartions.

## Permutation

Each of the different arrangements which can be made by taking some or all of given number of things or objects at a time is called a *permutation.*

***Note:***

Permutation of things means arrangement of things. The word arrangement is used if order of things is taken into account. Thus, if order of different things changes, then their arrangement also changes.

## Notation

Let $r$ and $n$ be positive integers such that $1 \le r \le n$. Then, the number of permutations of $n$ different things, taken $r$ at a time, is denoted by the symbol ${}^nP_r$ or $P(n, r)$.

## SOME BASIC RESULTS

1. $^nP_r$ or $P(n, r) = \dfrac{n!}{(n-r)!} = n\,(n-1)\,(n-2)$ $\ldots[n-(r+1)],\ 0 \le r \le n.$

**Illustration 7:** Evaluate the following:

(i) $P(6, 4)$,
(ii) $P(15, 3)$,
(iii) $P(30, 2)$.

**Solution:** (i) We have

$$P(6, 4) = \frac{6!}{(6-4)!} = \frac{6.5.4.3.2.1}{2.1} = 360.$$

(ii) We have

$$P(15, 3) = \frac{15!}{(15-3)!} = \frac{15!}{12!} = \frac{(15\cdot14\cdot13)\,(12!)}{12!} = 2730.$$

(iii) $$P(30, 2) = \frac{30!}{(30-2)!} = \frac{30!}{28!} = \frac{(30.29)\,(28!)}{28!}$$

$$= 870.$$

2. The number of permutations of $n$ things, taken all at a time, out of which $p$ are alike and are of one type, $q$ are alike and are of second type and rest are all different $= \dfrac{n!}{p!\,q!}$.

**Illustration 8:** There are 5 red, 4 white and 3 blue marbles in a bag. They are drawn one by one and arranged in a row. Assuming that all the 12 marbles ae drawn, determine the number of different arrangements.

**Solution:** Here, $n = 12$, $p_1 = 5$, $p_2 = 4$ and $p_3 = 3$

∴ The required number of different arrangements

$$= \frac{n!}{p_1!\,p_2!\,p_3!} = \frac{12!}{5!4!3!}$$

$$= \frac{12\cdot11\cdot10\cdot9\cdot8\cdot7\cdot6}{4\cdot3\cdot2\cdot1\cdot3\cdot2\cdot1} = \frac{11\cdot10\cdot9\cdot8\cdot7}{2}$$

$$= 990 \times 4 \times 7 = 27720.$$

3. The number of permutations of $n$ different things taken $r$ at a time when each thing may be repeated any number of times is $n^r$.

**Illustration 9:** In how many ways can 5 apples be distributed among 4 boys, there being no restriction to the number of apples each boy may get?

**Solution:** The required number of ways $= 4^5$.

4. **Permutations under Restrictions**

(a) Number of permutations of $n$ different things, taken $r$ at a time, when a particular thing is to be always included in each arrangement, is

$$r \cdot {}^{n-1}P_{r-1}.$$

(b) Number of permutations of $n$ different things, taken $r$ at a time, when $s$ particular things are to be always included in each arrangement, is

$$s!\ (r-(s-1)) \cdot {}^{n-s}P_{r-s}.$$

(c) Number of permutations of $n$ different things, taken $r$ at a time, when a particular thing is never taken in each arrangement, is

$$^{n-1}P_r.$$

(d) Number of permutations of $n$ different things, taken all at a time, when $m$ specified things always come together, is $m! \times (n-m+1)!$

(e) Number of permutations of $n$ different things, taken all at a time, when $m$ specified things never come together, is $n! - m! \times (n-m+1)!$.

5. **Circular Permutations**

(a) Number of circular arrangements (permutations) of $n$ different things $= (n-1)!$.

**Illustration 10:** In how many ways can eight people be seated at a round table?

**Solution:** Required number of ways $= (8-1)!$

$$= 7! = 5040.$$

(b) Number of circular arrangements (permutations) of $n$ different things when clockwise and anticlockwise arrangements are not different, that is, when observation can be made from both sides $= \dfrac{1}{2}(n-1)!$.

**Illustration 11:** Find the number of ways in which $n$ different beads can be arranged to form a necklace.
**Solution:** Required number of arrangements

$$= \frac{1}{2}(5-1)! = \frac{1}{2} \times 4! = 12.$$

## Combination

Each of the different groups or selections which can be made by taking some or all of a number of things (irrespective of order) is called a *combination*.

***Note:***

Combination of things means selection of things. Obviously, in selection of things order of things has no importance. Thus, with the change of order of things selection of things does not change.

**Notations** The number of combinations of $n$ different things taken $r$ at a time is denoted by ${}^nC_r$ or $C(n, r)$.

$$\text{Thus, } {}^nC_r = \frac{n!}{r!(n-r)!} \qquad (0 \le r \le n)$$

$$= \frac{{}^nP_r}{r!}$$

$$= \frac{n(n-1)(n-2)\dots(n-r+1)}{r(r-1)(r-2)\dots3\cdot2\cdot1}$$

If $r > n$, then ${}^nC_r = 0$.

**Illustration 12:** Evaluate:

**(i)** ${}^{11}C_3$ (ii) ${}^{10}C_8$ (iii) ${}^{100}C_{98}$

**Solution:**

(i) $${}^{11}C_3 = \frac{11!}{3!(11-3)!} = \frac{11!}{3!8!}$$

$$= \frac{11\times10\times9\times8!}{3\times2\times8!} = 165.$$

(ii) $${}^{10}C_8 = \frac{10!}{8!2!} = \frac{10\times9\times8!}{8!\times2} = 45.$$

(iii) $${}^{100}C_{98} = \frac{100!}{98!2!} = \frac{100\times99\times98!}{98!\times2} = 4950.$$

### Some Important Results

1. ${}^nC_r = {}^nC_{n-r}$
2. ${}^nC_0 = {}^nC_n = 1$, ${}^nC_1 = n$
3. If ${}^nC_x = {}^nC_y$ then either $x = y$ or $y = n - x$ that is, $x + y = n$.
4. ${}^nC_r + {}^nC_{r-1} = {}^{n+1}C_r$
5. $\dfrac{{}^nC_r}{{}^nC_{r-1}} = \dfrac{n-r+1}{r}$.
6. If $n$ is even then the greatest value of ${}^nC_r$ is ${}^nC_{n/2}$.
7. If $n$ is odd then the greatest value of ${}^nC_r$ is $${}^nC_{\frac{n+1}{2}} \text{ or } {}^nC_{\frac{n-1}{2}}.$$
8. $${}^nC_r = \frac{r \text{ decreasing numbers starting with } n}{r \text{ increasing numbers starting with } 1}$$ $$= \frac{n(n-1)(n-2)\dots(n-r+1)}{1\cdot2\cdot3\dots r.}$$
9. ${}^nC_0 + {}^nC_1 + {}^nC_2 + \cdots + {}^nC_n = 2^n$.
10. ${}^nC_0 + {}^nC_2 + {}^nC_4 + \cdots = {}^nC_1 + {}^nC_3 + {}^nC_5 + \dots = 2^{n-1}$.
11. Number of combinations of $n$ different things taken $r$ at a time
    (a) when $p$ particular things are always included $= {}^{n-p}C_{r-p}$
    (b) when $p$ particular things are never included $= {}^{n-p}C_r$
    (c) when $p$ particular things are not together in any selection $= {}^nC_r - {}^{n-p}C_{r-p}$.

**Illustration 13:** In how many ways can 5 members forming a committee out of 10 be selected so that

(i) two particular members must be included.
(ii) two particular members must not be included.

**Solution:**

(i) When two particular members are included, then, we have to select $5 - 2 = 3$ members out of $10 - 2 = 8$.

∴ The required number of ways

$$= C(8, 3) = \frac{8!}{3!5!} = \frac{8\times7\times6}{6} = 56.$$

(ii) When 2 particular members are not included, then, we have to select 5 members out of $10 - 2 = 8$.

∴ The required number of ways

$$= C(8, 5) = \frac{8!}{5!3!} = \frac{8\times7\times6}{6} = 56.$$

12. (a) Number of selections of $r$ consecutive things out of $n$ things in a row $= n - r + 1$.
(b) Number of selections of $r$ consecutive things out of $n$ things along a circle

$$\begin{cases} n, \text{ when } r < n \\ 1, \text{ when } r = n \end{cases}.$$

13. (a) Number of selections of zero or more things out of $n$ different things

$${}^nC_0 + {}^nC_1 + {}^nC_2 + \ldots + {}^nC_n = 2^n$$

(b) Number of combinations of $n$ different things selecting at least one of them is

$${}^nC_1 + {}^nC_2 + \ldots + {}^nC_n = 2^n - 1.$$

(c) Number of selections of $r$ things ($r \le n$) out of $n$ identical things is 1.
(d) Number of selections of zero or more things out of $n$ identical things $= n + 1$.
(e) Number of selections of one or more things out of $n$ identical things $= n$.
(f) If out of $(p + q + r + t)$ things, $p$ are alike of one kind, $q$ are alike of second kind, $r$ are alike of third kind and $t$ are different, then the total number of selections is $(p + 1)(q + 1)(r + 1)2^t - 1$.
(g) The number of ways of selecting some or all out of $p + q + r$ items where $p$ are alike of one kind, $q$ are alike of second kind and rest are alike of third kind is $[(p + 1)(q + 1)(r + 1)] - 1$.

14. (a) Number of ways of dividing $m + n$ different things in two groups containing $m$ and $n$ things, respectively ($m \ne n$):

$${}^{m+n}C_m = \frac{(m+n)!}{m!\,n!}.$$

(b) Number of ways of dividing $m + n + p$ different things in three groups containing $m$, $n$ and $p$ things, respectively ($m \ne n \ne p$):

$$\frac{(m+n+p)!}{m!\,n!\,p!}.$$

## SOME USEFUL SHORTCUT METHODS

1. The number of triangles which can be formed by joining the angular points of a polygon of $n$ sides as vertices are $\dfrac{n(n-1)(n-2)}{6}$.

**Illustration 14:** Find the number of triangles formed by joining the vertices of an octagon.

**Solution:** The required number of triangles

$$= \frac{n(n-1)(n-2)}{6}$$

$$= \frac{8(8-1)(8-2)}{6} = \frac{8\times7\times6}{6} = 56.$$

2. The number of diagonals which can be formed by joining the vertices of a polygon of $n$ sides are $\dfrac{n(n-3)}{2}$.

**Illustration 15:** How many diagonals are there in a decagon?

**Solution:** The required number of diagonals

$$= \frac{n(n-3)}{2} = \frac{10(10-3)}{2}$$

$$= \frac{10\times7}{2} = 35.$$

3. If there are '$m$' horizontal lines and '$n$' vertical lines then the number of different rectangles formed are given by $({}^mC_2 \times {}^nC_2)$.

**Illustration 16:** In a chess board there are 9 vertical and 9 horizontal lines. Find the number of rectangles formed in the chess board.

**Solution:** The require number of rectangles.

$$= {}^9C_2 \times {}^9C_2 = 36 \times 36 = 1296.$$

4. These are '$n$' points in a plane out of which '$m$' points are collinear. The number of triangles formed by the points as vertices are given by ${}^nC_3 - {}^mC_3$.

**Illustration 17:** There are 14 points in a plane out of which 4 are collinear. Fine the number of triangles formed by the points as vertices.

**Solution:** The required number of triangles

$$= {}^{14}C_3 - {}^{4}C_3 = 364 - 4 = 360.$$

5. There are '$n$' points in a plane out of which '$m$' points are collinear. The number of straight lines formed by joining them are given by
$$({}^{n}C_2 - {}^{m}C_2 + 1).$$

**Illustration 18:** There are 10 points in a plane out of which 5 are collinear. Find the number of straight lines formed by joining them.

**Solution:** The required number of straight lines

$$= {}^{n}C_2 - {}^{m}C_2 + 1$$
$$= {}^{10}C_2 - {}^{5}C_2 + 1 = 45 - 10 + 1 = 36.$$

6. If there are '$n$' points in a plane and no three points are collinear, then the number of triangles formed with '$n$' points are given by $\dfrac{n(n-1)(n-2)}{6}$.

**Illustration 19:** Find the number of triangles that can be formed with 14 points in a plane of which no three points are collinear.

**Solution:** The required number of triangles

$$= \frac{n(n-1)(n-2)}{6} = \frac{14 \times 13 \times 12}{6} = 364.$$

7. The number of quadrilaterals that can be formed by joining the vertices of a polygon of $n$ sides are given by $\dfrac{n(n-1)(n-2)(n-3)}{24}$, where $n > 3$.

**Illustration 20:** Find the number of quadrilaterals that can be formed by joining the vertices of a septagon.

**Solution:** The required number of quadrilaterals

$$= \frac{n(n-1)(n-2)(n-3)}{24}$$

$$= \frac{7(7-1)(7-2)(7-3)}{24}$$

$$= \frac{7 \times 6 \times 5 \times 4}{24} = 35.$$

8. There are $n$ points in a plane and no points are collinear, then the number of straight lines that can be drawn using these '$n$' points are given by $\dfrac{n(n-1)}{2}$.

**Illustration 21:** How many straight lines can be drawn with 18 points on a plane of which no points are collinear?

**Solution:** The required number of straight lines

$$= \frac{n(n-1)}{2} = \frac{18(18-1)}{2} = \frac{18 \times 17}{2} = 153.$$

9. In a party every person shakes hands with every other person. If there was a total of $H$ handshakes in the party, then the number of persons '$n$' who were present in the party can be calculated from the equation:
$$\frac{n(n-2)}{2} = H.$$

**Illustration 22:** In a party every person shakes hands with every other person. If there was a total of 105 handshakes in the party, find the number of persons who were present in the party.

**Solution:** Let '$n$' be the number of persons present in the party.

We have, the equation

$$\frac{n(n-1)}{2} = H$$

$$\Rightarrow \quad \frac{n(n-1)}{2} = 105$$

$$\Rightarrow \quad n(n-1) = 15 \times (15-1) \Rightarrow n = 15.$$

## Exercise-I

1. There are 6 candidates for 3 posts. In how many ways can the posts be filled?
(a) 120 (b) 130
(c) 100 (d) 110

2. From among the 36 teachers in a school, one principal and one vice-principal are to be appointed. In how many ways can this be done?
(a) 1360 (b) 1260
(c) 1060 (d) 1160

3. There are 15 buses running between Delhi and Mumbai. In how many ways can a man go to Mumbai and return by a different bus?
(a) 280 (b) 310
(c) 240 (d) 210

4. A teacher of a class wants to set 1 question from each of 2 exercises in a book. If there are 15 and 12 questions in the 2 exercises respectively, then in how many ways can the 2 questions be selected?
(a) 160 (b) 140
(c) 180 (d) 120

5. The students in a class are seated according to their marks in the previous examination. Once, it so happens that four of the students got equal marks and therefore the same rank. To decide their seating arrangement, the teacher wants to write down all possible arrangements one in each of separate bits of paper in order to choose one of these by lots. How many bits of paper are required?
(a) 24 (b) 12
(c) 48 (d) 36

6. For a set of 5 true-or-false questions, no student has written all the correct answers, and no 2 students have given the same sequence of answers. What is the maximum number of students in the class, for this to be possible?
(a) 31 (b) 21
(c) 51 (d) 41

7. A code word is to consist of 2 English alphabets followed by 2 distinct numbers between 1 and 9. For example, CA23 is a code word. How many such code words are there?
(a) 615800 (b) 46800
(c) 719500 (d) 410800

8. There are 6 multiple choice questions on an examination. How many sequences of answers are possible, if the first three questions have 4 choices each and the next 3 have 5 each?
(a) 6000 (b) 5000
(c) 4000 (d) 8000

9. There are 6 multiple choice questions in an examination. How many sequences of answers are possible, if the first 2 questions have 3 choices each, the next 2 have 4 choices each and the last two have 5 choices each?
(a) 3450 (b) 3300
(c) 3600 (d) 3400

10. Each section in the first year of plus 2 course has exactly 40 students. If there are 5 sections, in how many ways can a set of 4 student representatives be selected, 1 from each section?
(a) 2560000 (b) 246500
(c) 2240000 (d) 2360000

11. There are 5 letters and 5 directed envelopes. Find the number of ways in which the letters can be put into the envelopes so that all are not put in directed envelopes?
(a) 129 (b) 119
(c) 109 (d) 139

12. There horses $H_1$, $H_2$, $H_3$ entered a field which has 7 portions marked $P_1$, $P_2$, $P_3$, $P_4$, $P_5$, $P_6$ and $P_7$. If no 2 horses are allowed to enter the same portion of the field, in how many ways can the horses graze the grass of the field?
(a) 195 (b) 205
(c) 185 (d) 210

13. How many different numbers of 2-digits can be formed with the digits 1, 2, 3, 4, 5, 6; no digits being repeated?
(a) 40 (b) 30
(c) 35 (d) 45

14. How many 3-digit odd numbers can be formed from the digits 1, 2, 3, 4, 5, 6 when
(i) repitition of digits is not allowed
(ii) repitition of digits is allowed?
(a) (i) 60, (ii) 108 (b) (i) 50, (ii) 98
(c) (i) 70, (ii) 118 (d) (i) 80, (ii) 128

**15.** How many 2-digit odd numbers can be formed from the digits 1, 2, 3, 4 5 and 8, if repitition of digits is allowed?

(a) 5 (b) 15
(c) 35 (d) 25

**16.** How many odd numbers less than 1000 can be formed using the digits 0, 2, 5, 7? (repetition of digits is allowed).

(a) 52 (b) 32
(c) 22 (d) 42

**17.** How many 3-digit numbers each less than 600 can be formed from the digits 1, 2, 3, 4, 5 and 9, if repetition of digits is allowed?

(a) 180 (b) 160
(c) 165 (d) 185

**18.** How many words (with or without meaning) of 3 distinct English alphabets are there?

(a) 15600 (b) 14650
(c) 12800 (d) 13700

**19.** How many numbers are there between 100 and 1000 in which all the digits are distinct?

(a) 548 (b) 648
(c) 748 (d) 756

**20.** How many integers between 1000 and 10000 have no digits other than 4, 5 or 6?

(a) 91 (b) 51
(c) 81 (d) 71

**21.** A number lock on a suitcase has 3 wheels each labelled with 10 digits from 0 to 9. If opening of the lock is a particular sequence of 3 digits with no repeats, how many such sequences will be possible?

(a) 720 (b) 760
(c) 680 (d) 780

**22.** A customer forgets a 4-digit code for an Automatic Teller Machine (A.T.M.) in a bank. However, he remembers that this code consists of digits 3, 5, 6 and 9. Find the largest possible number of trials necessary to obtain the correct code.

(a) 12 (b) 24
(c) 48 (d) 36

**23.** If $(n + 2)! = 2550(n!)$, find $n$

(a) 38 (b) 35
(c) 49 (d) 43

**24.** If $(n + 1)! \ = 6[(n - 1)!]$, find $n$

(a) 6 (b) 4
(c) 8 (d) 2

**25.** If $\dfrac{n!}{2!(n-2)!}$ and $\dfrac{n!}{4!(n-4)!}$ are in the ratio 2:1, find the value of $n$.

(a) 0 (b) 1
(c) 2 (d) 3

**26.** Find $n$ if ${}^{n}P_4 = 18.\ {}^{n-1}P_2$.

(a) 4 (b) 8
(c) 6 (d) 12

**27.** If $P(56, r + 6):P(54, r + 3) = 30800:1$, find $r$.

(a) 51 (b) 41
(c) 31 (d) 43

**28.** In how many ways can 10 people line up at a ticket window of a cinema hall?

(a) 3628800 (b) 3482800
(c) 344800 (d) 3328800

**29.** How many words, with or without meaning, can be formed using all letters of the word EQUATION, using each letter exactly once?

(a) 38320 (b) 39320
(c) 40320 (d) 38400

**30.** Ten students are participating in a race. In how many ways can the first 3 prizes be won?

(a) 920 (b) 680
(c) 820 (d) 720

**31.** It is required to seat 5 men and 4 women in a row so that the women occupy the even places. How many such arrangements are possible?

(a) 2880 (b) 2480
(c) 3680 (d) 3280

**32.** 4 books, 1 each in Chemistry, Physics, Biology and Mathematics are to be arranged in a shelf. In how many ways can this be done?

(a) 12 (b) 36
(c) 24 (d) 48

**33.** There are 3 different rings to be worn in four fingers with at most 1 in each finger. In how many ways can this be done?

(a) 36 (b) 28
(c) 24 (d) 32

**34.** In an examination hall, there are 4 rows of chairs. Each row has 8 chairs 1 behind the other. There are 2 classes sitting for the examination with 16 students in each class. It is desired that in each row all students belong to the same class and that no 2 adjacent rows are allotted to the same class. In how many ways can these 32 students be seated?

(a) $2 \times 16! \times 16!$ (b) $2 \times 15! \times 15!$
(c) $2 \times 16! \times 15!$ (d) None of these

**35.** How many numbers lying between 1000 and 10000. can be formed by using the digits 1, 3, 5, 6, 7, 8, 9, no digits being repeated?
(a) 940 (b) 640
(c) 840 (d) 740

**36.** How many different numbers of 6 digits can be formed with the numbers 3, 1, 7, 0, 9, 5?
(a) 500 (b) 400
(c) 400 (d) 600

**37.** How many 3-digit numbers are there, with no digits repeated?
(a) 648 (b) 548
(c) 848 (d) 748

**38.** If there are 6 periods in each working day of a school, in how many ways can 1 arrange 5 subjects such that each subject is allowed at least 1 period?
(a) 3500 (b) 3600
(c) 3550 (d) 3650

**39.** 4 alphabets E, K, S and V, one in each, were purchased from a plastic warehouse. How many ordered pairs of alphabets, to be used as initials, can be formed from them?
(a) 18 (b) 12
(c) 14 (d) 16

**40.** There are 8 students appearing in an examination of which 3 have to appear in a Mathematics paper and the remaining 5 in different subjects. In how many ways can they be made to sit in a row if the candidates in Mathematics cannot sit next to each other?
(a) 14400 (b) 16400
(c) 15400 (d) 17400

**41.** Find how many words can be formed out of the letters of the word 'ORIENTAL' so that vowels always occupy the odd places.
(a) 576 (b) 578
(c) 676 (d) None of these

**42.** The number of different 6-digit numbers that are divisible by 10, which can be formed using the digits 1, 2, 7, 0, 9, 5?
(a) 100 (b) 120
(c) 140 (d) 160

**43.** In how many ways can the letters of the word 'UNIVERSAL' be arranged? In how many of these will E, R, S always occur together?
(a) 32240 (b) 30240
(c) 30240 (d) 31240

**44.** The principal wants to arrange 5 students on the platform such that the boy SUNIL occupies the second position and such that the girl GITA is always adjacent to the girl NITA. How many such arrangements are possible?
(a) 12 (b) 8
(c) 14 (d) 16

**45.** In how many different ways, the letters of the work ALGEBRA can be arranged in a row if
(i) The 2 As are together?
(ii) The 2 As are not together?
(a) (i) 720, (ii) 1800
(b) (i) 620, (ii) 1600
(c) (i) 780, (ii) 1860
(d) (i) 720, (ii) 1600

**46.** In how many ways can 6 apples be distributed among 3 boys, there being no restriction to the number of apples each boy may get?
(a) 729 (b) 739
(c) 759 (d) 749

**47.** In how many different ways can the letters of the word 'KURUKSHETRA' be arranged?
(a) 4497600 (b) 4979600
(c) 4989600 (d) 4789600

**48.** In how many different ways can the letters of the word 'ALLAHABAD' be permuted?
(a) 7560 (b) 7840
(c) 7460 (d) 7650

**49.** How many 3-digit numbers can be formed by using the digits 1, 3, 6 and 8, when the digits may be repeated any number of times?
(a) 48 (b) 64
(c) 80 (d) 32

**50.** How many 3-digit numbers can be formed by using the digits 0, 2, 3, 6, 8 when the digits may be repeated any number of times?
(a) 110 (b) 120
(c) 100 (d) None of these

**51.** How many different words can be formed with the letters of the word 'BHARAT'?
In how many of these B and H are never together?
(a) 240, 180 (b) 360, 240
(c) 320, 200 (d) 380, 260

**52.** How many arrangements can be made of the letters of the word 'ARRANGEMENT'?
(a) 2492800 (b) 249300
(c) 2494800 (d) 2491800

**53.** If the different permutations of the word EXAMINATION are listed as in a dictionary, how many items are there in this list before the first word starting with E?

(a) 906200 (b) 907200
(c) 908200 (d) 905200

**54.** How many 5-digit even numbers can be formed using the digits 1, 2, 5, 5, 4?

(a) 16 (b) 36
(c) 24 (d) 48

**55.** How many numbers greater than a million can be formed with the digits 2, 3, 0, 3, 4, 2, 3?

(a) 360 (b) 240
(c) 480 (d) None of these

**56.** Find the number of arrangements of the letters of the word 'ALGEBRA' without altering the relative position of the vowels and the consonants.

(a) 80 (b) 48
(c) 64 (d) 72

**57.** In how many ways can the letters of the word BALLOON be arranged so that two Ls do not come together?

(a) 900 (b) 1200
(c) 800 (d) 600

**58.** How many different signals can be transmitted by arranging 3 red, 2 yellow and 2 green flags on a pole? [Assume that all the 7 flags are used to transmit a signal.]

(a) 220 (b) 240
(c) 200 (d) 210

**59.** How many numbers can be formed with the digits 1, 2, 3, 4, 3, 2, 1, so that odd digits always occupy the odd places?

(a) 36 (b) 24
(c) 18 (d) 12

**60.** There are 5 gentlemen and 4 ladies to dine at a round table. In how many ways can they seat themselves so that no 2 ladies are together?

(a) 3280 (b) 2880
(c) 2080 (d) 2480

**61.** 3 boys and 3 girls are to be seated around a table in a circle. Among the boys, X does not want any girl neighbour and the girl Y does not want any boy neighbour. How many such arrangements are possible?

(a) 6 (b) 4
(c) 8 (d) 2

**62.** How many different necklaces can be formed with 6 white and 5 red beads?

(a) 18 (b) 24
(c) 21 (d) 27

**63.** The Chief Ministers of 11 States of India meet to discuss the language problem. In how many ways can they seat themselves at a round table so that the Punjab and Madras Chief Ministers sit together?

(a) 725760 (b) 625760
(c) 925760 (d) 825760

**64.** If $C(n, 7) = C(n, 5)$, find $n$

(a) 15 (b) 12
(c) 18 (d) 2

**65.** If $C(n, 8) = C(n, 6)$, find $C(n, 2)$

(a) 91 (b) 81
(c) 61 (d) 71

**66.** If the ratio $C(2n, 3):C(n, 3)$ is equal to 11:1, find $n$.

(a) 6 (b) 9
(c) 12 (d) 18

**67.** If ${}^{2n}C_r = {}^{2n}C_{r+2}$; find $r$.

(a) $n - 1$ (b) $n - 2$
(c) $n - 4$ (d) $n - 3$

**68.** If ${}^{18}C_r = {}^{18}C_{r+2}$; find ${}^{r}C_5$.

(a) 56 (b) 63
(c) 49 (d) 42

**69.** If $12\ {}^{n}C_2 = {}^{2n}C_3$:find $n$.

(a) 7 (b) 5
(c) 9 (d) 3

**70.** Find $\sum_{r=1}^{5} C(5, r)$

(a) 41 (b) 31
(c) 51 (d) 61

**71.** In how many ways can 5 sportsmen be selected from a group of 10?

(a) 272 (b) 282
(c) 252 (d) 242

**72.** In how many ways can a cricket team of 11 players be selected out of 16 players, if 2 particular player are always to be included?

(a) 2006 (b) 2004
(c) 2008 (d) 2002

**73.** In how many ways can a cricket team of 11 players be selected out of 16 players if 1 particular players is to be excluded?

(a) 1565 (b) 1365
(c) 1165 (d) 1265

**74.** In how many ways can a cricket team of 11 players be selected out of 16 players if 2 particular players are to be included and 1 particular player is to be rejected?

(a) 715 (b) 615
(c) 915 (d) 515

**75.** A question paper has 2 parts, part A and part B, each containing 10 questions. If the student has to choose 8 from part A and 5 from part B, in how many ways can he choose the question?

(a) 11240 (b) 12240
(c) 13240 (d) 11340

**76.** In how many ways can a football team of 11 players be selected from 15 players? In how many cases a particular player be included?

(a) 1101 (b) 1011
(c) 1001 (d) 1111

**77.** How many words, each of 3 vowels and 2 consonants, can be formed from the letters of the word 'INVOLUTE'?

(a) 2280 (b) 2480
(c) 2880 (d) 2680

**78.** How many lines can be drawn through 21 points on a circle?

(a) 310 (b) 210
(c) 410 (d) 570

**79.** Find the number of ways of selecting 9 balls from 6 red balls, 5 white balls and 5 blue balls, if each selection consists of 3 balls of each colour.

(a) 3000 (b) 1000
(c) 2000 (d) 4000

**80.** In how many ways can a student choose a programme of 5 courses if 9 courses are available and 2 courses are compulsory for every student?

(a) 45 ways (b) 35 ways
(c) 55 ways (d) 65 ways

**81.** In an examination, Yamini has to select 4 questions from each part. There are 6, 7 and 8 questions in Part I, Part II and Part III, respectively. What is the number of possible combinations in which she can choose the questions?

(a) 39650 (b) 37650
(c) 36750 (d) 38750

**82.** We wish to select 6 persons from 8, but if the person A is chosen, then B must be chosen too. In how many ways can the selection be made?

(a) 24 (b) 32
(c) 16 (d) 40

## Exercise-2
## (Based on Memory)

**1.** In how many different ways can the letters of the word 'MIRACLE' be arranged?

(a) 720 (b) 5040
(c) 2520 (d) 40320
(e) None of these

**[SBI PO, 2008]**

**2.** In how many different ways can the letters of the word 'BLOATING' be arranged?

(a) 40320 (b) 5040
(c) 2520 (d) 20160
(e) None of these

**[Bank of Maharashtra PO, 2008]**

**3.** In how many different ways can the letters of the word 'GAMBLE' be arranged?

(a) 720 (b) 840
(c) 360 (d) 420
(e) None of these

**[NABARD PO, 2008]**

**Directions (4–8):** From the following, different committees are to be made as per the requirement given in each question. In how many different ways can it be done?

10 men and 8 women out of which 5 men are teachers, 3 men are doctors and 2 are businessmen. Among the women, 3 are teachers, 2 doctors, 2 researchers and 1 social worker.

**4.** A committee of 5 in which 3 men and 2 women are there.

(a) 3360
(b) 8568
(c) 4284
(d) 1680
(e) None of these

**5.** A committee of 4 in which at least 2 women are there.

(a) 75 (b) 150
(c) 214 (d) 20
(e) None of these

**6.** A committee of 5 in which 2 men teachers, 2 women teachers and 1 doctor are there.

(a) 75 (b) 150
(c) 214 (d) 20
(e) None of these

**7.** A committee of 7.

(a) 31824 (b) 1200
(c) 9600 (d) 15912
(e) None of these

**8.** A committee of 3 in which there is no teacher and no doctor.

(a) 100 (b) 120
(c) 10 (d) 12
(e) None of these

**[Andhra Bank IT Officer, 2007]**

**9.** In how many different ways can the letters of the word 'FLEECED' be arranged?

(a) 840 (b) 2520
(c) 1680 (d) 49
(e) None of these

**[Bank of Maharashtra PO, 2007]**

**10.** In how many ways can 6 people be seated on a sofa if there are only 3 seats available?

(a) 18 (b) 120
(c) 2 (d) 216
(e) None of these

**[IDBI Bank Officers' 2007]**

**11.** In how many ways can 5 colours be selected out of 9?

(a) 98 (b) 142
(c) 72 (d) 126
(e) None of these

**[Andhra Bank PO, 2007]**

**12.** In how many different ways can the letters of the word 'PADDLED' be arranged?

(a) 910 (b) 2520
(c) 5040 (d) 840
(e) None of these

**[Corporation Bank PO, 2006]**

**13.** In how many different ways can 6 children be seated on 6 seats?

(a) 360 (b) 120
(c) 590 (d) 740
(e) None of these

**[LIC ADO, 2007]**

**14.** In how many different ways can the letters of the word 'PRIDE' be arranged?

(a) 60 (b) 120
(c) 15 (d) 360
(e) None of these

**[Bank of Baroda PO, 2007]**

**15.** In how many different ways can the letters of the word 'WEDDING' be arranged?

(a) 5040 (b) 2500
(c) 2520 (d) 5000
(e) None of these

**[OBC PO, 2007]**

**16.** A select group of 4 is to be formed from 8 men and 6 women in such a way that the group must have atleast 1 woman. In how many different ways can it be done?

(a) 364 (b) 1001
(c) 728 (d) 931
(e) None of these

**[SBI PO, 2005]**

**17.** On 5 chairs arranged in a row, 5 persons A, B, C, D and E are to be seated in such a way that B and D always sit together (side by side). In how many different ways can it be done?

(a) 120 (b) 48
(c) 60 (d) 24
(e) None of these

**[SBI PO, 2005]**

**18.** In how many different ways can the letters of the word 'PRAISE' be arranged?

(a) 720 (b) 610
(c) 360 (d) 210
(e) None of these

**[Andhra Bank PO, 2006]**

**19.** 4 boys and 3 girls are to be seated in a row in such a way that no 2 boys sit adjacent to each other. In how many different ways can it be done?

(a) 5040 (b) 30
(c) 144 (d) 72
(e) None of these

**[SBI PO, 2005]**

**20.** A committee of 3 members is to be formed out of 3 men and 4 women. In how many different ways can it be done so that at least 1 member is a woman?

(a) 34 (b) 12
(c) 30 (d) 36
(e) None of these

**[SBI PO, 2005]**

**21.** A speaks truth in 75% and B in 80% cases. In what percentage of cases are they likely to contradict each other when narrating the same incident?
(a) 35 (b) 30
(c) 25 (d) 20
(e) None of these
**[BSRB Chennai PO, 2000]**

**22.** In a box there are 8 red, 7 blue and 6 green balls. 1 ball is picked up randomly. What is the probability that it is neither red nor green?
(a) $\frac{7}{19}$ (b) $\frac{2}{3}$
(c) $\frac{3}{4}$ (d) $\frac{9}{21}$
(e) None of these

**23.** How many different ways can the letters in the word ATTEND be arranged?
(a) 60 (b) 120
(c) 240 (d) None of these
**[Allahabad Bank PO, 2010]**

**24.** In how many different ways can the letters of the word 'CYCLE' be arranged?
(a) 120 (b) 240
(c) 30 (d) None of these
**[Punjab National Bank PO, 2010]**

**25.** In how many different ways can the letters of the word DESIGN by arranged so that the vowels are at the 2 ends?
(a) 48 (b) 72
(c) 36 (d) 24
**[United Bank of India PO, 2009]**

**26.** In how many different ways can the letters of the word 'SMART' be arranged?
(a) 25 (b) 60
(c) 180 (d) None of these
**[IOB PO, 2009]**

**27.** In how many different ways can the letters of the word 'THERAPY' be arranged so that the vowels never come together?
(a) 720 (b) 1440
(c) 5040 (d) 3600
(e) 4800
**[IBPS PO/MT, 2012]**

**28.** In how many different ways can the letters of the word 'PRAISE' be arranged?
(a) 720 (b) 610
(c) 360 (d) 210
(e) None of these
**[Andhra Bank PO, 2011]**

**29.** In how many different ways can the letters of the word 'PRAISE' be arranged?
(a) 720 (b) 610
(c) 360 (d) 210
(e) None of these
**[Punjab and Sind Bank PO, 2011]**

**30.** In how many different ways can the letters of the word'BANKING' be arranged?
(a) 5040 (b) 2540
(c) 5080 (d) 2520
(e) None of these
**[Corporation Bank PO, 2010]**

**31.** When all the students in a school are made to stand in rows of 54,30 such rows are formed. If the students are made to stand in rows of 45, how many such rows will be formed?
(a) 25 (b) 42
(c) 36 (d) 32
(e) None of these
**[Corporation Bank PO, 2010]**

**32.** In how many different ways can the letters in the word ATTEND be arranged?
(a) 60 (b) 120
(c) 240 (b) 80
(e) None of these
**[Allahabad Bank PO, 2010]**

**Directions (Q. 33–35):** Study the given information carefully and answer the questions that follow:

A committee of 5 members is to be formed out of 3 trainees, 4 professors and 6 research associates. In how many different ways can this be done if:

**33.** The committee should have all 4 professors and 1research associate or all 3 trainees and 2 professors?
(a) 12 (b) 13
(c) 24 (d) 52
(e) None of these
**[SBI Associate Banks PO, 2010]**

**34.** The committee should have 2 trainees and 3 research associates?
(a) 15 (b) 45
(c) 60 (d) 9
(e) None of these
**[SBI Associate Banks PO, 2010]**

**35.** In how many different ways can the letters of the word 'OFFICES' be arranged?
(a) 2520 (b) 5040
(c) 1850 (d) 1680
(e) None of these
**[Indian Bank PO, 2010]**

**Directions (Q. 36–41):** Study the following information carefully to answer the questions that follow:

A committee of 5 members is to be formed out of 5 Professors, 6 Teachers and 3 Readers.

In how many different ways can it be done if:

**36.** The committee should consist of 2 Professors, 2 Teachers and 1 Reader?

(a) 450 (b) 225
(c) 55 (d) 90
(e) None of these

**[IDBI Bank PO, 2009]**

**37.** The committee should include all the 3 Readers?

(a) 90 (b) 180
(c) 21 (d) 55
(e) None of these

**[IDBI Bank PO, 2009]**

**38.** In how many different ways can 4 boys and 3 girls be arranged in arow such that all the boys stand together and all the girls stand together?

(a) 75 (b) 576
(c) 288 (d) 24
(e) None of these

**[IDBI Bank PO, 2009]**

**39.** In how many different ways can the letters of the word TRUST be arranged?

(a) 240 (b) 120
(c) 80 (d) 25
(e) None of these

**[OBC PO, 2009]**

**40.** In how many different ways can the letters of the word 'FINANCE' be arranged?

(a) 5040
(b) 2040
(c) 2510
(d) 4080
(e) None of these

**[NABARD Bank Officer 2009]**

**41.** A school team has 8 volleyball players. A 5-member team and a captain will be selected out of these 8 players. How many different selections can be made?

(a) 224 (b) 112
(c) 56 (d) 88
(e) None of these

**[Corporation Bank PO, 2009]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (c) | **3.** (d) | **4.** (c) | **5.** (a) | **6.** (a) | **7.** (b) | **8.** (d) | **9.** (c) | **10.** (a) | **11.** (b) | **12.** (d) | **13.** (b) |
| **14.** (a) | **15.** (b) | **16.** (b) | **17.** (a) | **18.** (a) | **19.** (b) | **20.** (c) | **21.** (a) | **22.** (b) | **23.** (c) | **24.** (d) | **25.** (a) | **26.** (c) |
| **27.** (b) | **28.** (a) | **29.** (c) | **30.** (d) | **31.** (a) | **32.** (c) | **33.** (c) | **34.** (a) | **35.** (c) | **36.** (d) | **37.** (a) | **38.** (b) | **39.** (b) |
| **40.** (a) | **41.** (a) | **42.** (b) | **43.** (b) | **44.** (a) | **45.** (a) | **46.** (a) | **47.** (c) | **48.** (a) | **49.** (b) | **50.** (c) | **51.** (b) | **52.** (b) |
| **53.** (b) | **54.** (c) | **55.** (a) | **56.** (d) | **57.** (a) | **58.** (d) | **59.** (c) | **60.** (b) | **61.** (b) | **62.** (c) | **63.** (a) | **64.** (b) | **65.** (a) |
| **66.** (a) | **67.** (a) | **68.** (a) | **69.** (b) | **70.** (b) | **71.** (c) | **72.** (d) | **73.** (b) | **74.** (a) | **75.** (d) | **76.** (c) | **77.** (c) | **78.** (b) |
| **79.** (c) | **80.** (b) | **81.** (c) | **82.** (c) | | | | | | | | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (a) | **3.** (a) | **4.** (a) | **5.** (e) | **6.** (b) | **7.** (a) | **8.** (c) | **9.** (a) | **10.** (b) | **11.** (d) | **12.** (d) | **13.** (e) |
| **14.** (b) | **15.** (c) | **16.** (d) | **17.** (b) | **18.** (a) | **19.** (c) | **20.** (a) | **21.** (a) | **22.** (e) | **23.** (d) | **24.** (d) | **25.** (a) | **26.** (d) |
| **27.** (d) | **28.** (a) | **29.** (a) | **30.** (d) | **31.** (c) | **32.** (e) | **33.** (a) | **34.** (c) | **35.** (a) | **36.** (a) | **37.** (d) | **38.** (c) | **39.** (e) |
| **40.** (e) | **41.** (e) | | | | | | | | | | | |

# EXPLANATORY ANSWERS

## EXERCISE-I

**1.** **(a)** The 1st post can be filled up in 6 ways.

The 2nd post can be filled up in 5 way.

and the 3rd post can be filled up in 4 ways.

∴ By the principle of association, the 3 posts can be filled up in $6 \times 5 \times 4 = 120$ ways.

**2.** **(c)** There are 36 teachers and every 1 has equal chance of being selected as a principal. Hence, the principal can be appointed in 36 ways. When 1 person is appointed as principal, we are left with 35 teachers. Out of these 35 teachers, we can select 1 vice-principal. So, a vice-principal can be selected in 35 ways. Hence, the number of ways in which a principal and vice-principal can be selected $= 36 \times 35 = 1260$.

**3.** **(d)** The first event of going from Delhi to Mumbai can be performed in 15 ways as he can go by any of the 15 buses. But the event of coming back from Mumbai can be performed in 14 ways (a different bus is to be taken).

Hence, both the events can be performed in

$$15 \times 14 = 210 \text{ ways.}$$

**4.** **(c)** Since the first exercise contains 15 questions, the number of ways of choosing the first question is 15. Since the second exercise contains 12 questions, the number of ways of choosing the second question is 12. Hence, by the fundamental principle, 2 questions can be selected in $= 15 \times 12 = 180$ ways.

**5.** **(a)** We are given that 4 students got equal marks. On 1 bit of paper, 1 arrangement of rank is to be written. Let, the students be named as P, Q, R and S.

Now, P can be treated as having rank I in 4 ways Q can be treated as having rank II in 3 ways

R can be treated as having rank III in 2 ways

S can be treated as having rank IV in 1 way.

∴ Total number of bits of paper required for all arrangements $= 4 \times 3 \times 2 \times 1 = 24$.

**6.** **(a)** Question I can be answered in 2 ways.

Question II can be answered in 2 ways.

Similarly questions III, IV, V each can be answered in 2 ways. Hence, total number of possible different answers $= 2 \times 2 \times 2 \times 2 \times 2 = 32$.

There is only one sequence of all correct answers

Thus, the total number of sequences are $32 - 1 = 31$

[Since no student has written all correct answers]

Now, as no 2 students have given the same sequence of answers, hence the maximum number of students in the class = 31.

**7.** **(b)** (i) There are in all 26 English alphabets.

We have to choose 2 distinct alphabets.

First alphabet can be selected in 26 ways.

Second alphabet can be selected in 25 ways.

Again, out of 9 digits (1 to 9), first digit can be selected in 9 ways. Second digit can be selected in 8 ways

Thus, the number of distinct codes

$= 26 \times 25 \times 9 \times 8$

$= 46800$.

**8.** **(d)** Each of the first 3 questions can be answered in 4 ways.

Each of the last 3 questions can be answered in 5 ways.

∴ By the fundamental principle of counting, sequences of answers are

$4 \times 4 \times 4 \times 5 \times 5 \times 5 = 64 \times 125 = 8000$.

**9.** **(c)** First question can be answered in 3 ways.

Second question can be answered in 3 ways.

3 question can be answered in 4 ways.

4 question can be answered in 4 ways.

5 question can be answered in 5 ways.

6 question can be answered in 5 ways.

Hence, by fundamental principle of counting, the required number of sequences of answers

$= 3 \times 3 \times 4 \times 4 \times 5 \times 5 = 3600$.

**10.** **(a)** 1 student representative can be selected from section I in 40 ways.

1 student representative can be selected from section II in 40 ways.

1 student representative can be selected from section III in 40 ways.

1 student representative can be selected from section IV in 40 ways

Hence, the number of ways in which a set of 4 student representatives can be selected

$= 40 \times 40 \times 40 \times 40$

$= 2560000$.

**11.** **(b)** Here, the first letter can be put in any 1 of the 5 envelopes in 5 ways. Second letter can be put in any 1 of the 4 remaining envelopes in 4 ways. Continuing in this way, we get the total number of ways in which 5 letters can be put into 5 envelopes $= 5 \times 4 \times 3 \times 2 \times 1 = 120$.

Since out of the 120 ways, there is 1 one way for putting each letter in the correct envelope. Hence, the number of ways of putting letters all not in directed envelopes $= 120 - 1 = 119$ ways.

**12.** **(d)** $H_1$ can graze the grass of either $P_1$ or $P_2$ or $P_3$ ..., or $P_7$, that is, in 7 ways. After $H_1$ entered the field, there are 6 portions left for $H_2$ as no 2 can enter into the same portion of the field. After first 2 entered the field, $H_3$ can enter the field in 5 ways.

∴ By the fundamental principle of counting, the 3 horses can graze the grass of the field in 7 × 6 × 5 = 210 ways.

**13.** **(b)** We have to fill up two places (since numbers are of 2 digits.

The first place can be filled up in 6 ways, as any 1 of the 6 digits can be placed in the first place. The 2nd place can be filled up in 5 ways as no digit is to be repeated. Hence, both places can be filled up in 6 × 5 = 30 ways.

**14.** **(a)**

(i) When repetition of digits is not allowed: Since we have to form a 3-digit odd number, thus the digit at unit's place must be odd. Hence, the unit's place can be filled up by 1, 3 or 5, that is, in 3 ways.

Now, the ten's digit can be filled up by any of the remaining 5 digits in 5 ways and then the hundred's place can be filled up by the remaining 4 digits in 4 ways.

Hence, the number of 3-digit odd numbers that can be formed = 3 × 4 × 5 = 60.

(ii) When repetition of digits is allowed: Again, the unit's place can be filled up by 1, 3, 5, that is, in 3 ways. But the ten's and hundred's place can be filled up by any of the 6 given digits in 6 ways each. (Since repetition is allowed)

Hence, the number of 3-digit odd numbers that can be formed = 3 × 6 × 6 = 108.

**15.** **(b)** The number is odd if 1 or 3 or 5 appears in the unit's place. Therefore, 3 are three ways of filling the unit's place.

Since repetition of digits is allowed, the ten's place can be filled by any of the 5 digits 1, 3, 4, 5 and 8. Hence, number of 2-digit odd numbers = 3 × 5 = 15.

**16.** **(b)** Since the required numbers are less than 1000, they are 1-digit, 2-digit or 3-digit numbers.

(i) Only 2 1-digit odd numbers are possible, namely 5 and 7.

(ii) For 2-digit odd numbers, the unit's place can be filled up by 5 or 7 in 2 ways and ten's place can be filled up by 2, 5 or 7 (not 0) in 3 ways.

∴ Possible 2-digit odd numbers = 2 × 3 = 6

(iii) For 3-digit odd numbers, the unit's place can be filled up by 5 or 7 in 2 ways. The ten's place can be filled up by any 1 of the given 4 digits in 4 ways. The hundred's place can be filled up by 2, 5 or 7 (not 0) in 3 ways.

∴ Possible 3-digit odd number = 2 × 4 × 3 = 24

∴ Required number of numbers = 2 + 6 + 24 = 32.

**17.** **(a)** Unit's place can be filled in 6 ways by any 1 of the digits 1, 2, 3, 4, 5 or 9. Also, ten's place can be filled in 6 ways. But hundred's place can be filled only is 5 ways using either 1, 2, 3, 4 or 5 ; 9 cannot be filled in hundred's place as the required number is < 600.

∴ Required number of numbers = 6 × 6 × 5 = 180.

**18.** **(a)** There are 26 distinct English alphabets. First alphabet can be chosen in 26 ways. Second alphabet can be chosen in 25 ways. Third alphabet can be chosen in 24 ways

Number of 3 letter words = 26 × 25 × 24
= 15600.

**19.** **(b)** Any number between 100 and 1000 is of 3 digits. Since the numbers should have distinct digits, repetition of digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 is not allowed.

Also 0 cannot be placed on the extreme left place. Hundredth place can be filled in 9 ways. Tenth place can be filled in 9 ways. Unit's place can be filled in 8 ways.

∴ The total 3-digit numbers
= 9 × 9 × 8 = 648.

**20.** **(c)** Any number between 1000 and 10000 is of 4 digits. The unit's place can be filled up by 4 or 5 or 6, that is, in 3 ways.

Similarly, the ten's place can be filled up by 4 or 5 or 6, that is, in 3 ways. The hundred's place can be filled up by 4 or 5 or 6, that is in 3 ways and the thousand's place can be filled up by 4 or 5 or 6, that is, in 3 ways.

Hence, the required number of numbers
= 3 × 3 × 3 × 3 = 81.

**21.** **(a)** On first wheel there can be 10 digits. On the second wheel there will be 1 of the 9 digits and on the third wheel there will be 8 digits. Therefore, the number of numbers is 10 × 9 × 8 = 720.

**22.** **(b)** At the first place he can try any of the 4 digits hence in first trial he tries 4 digits. In the second place he will try 3 remaining digits. Similarly, he will try 2 and 1 digit at the third and fourth places.

Thus, the number of trials is = 4 × 3 × 2 × 1 = 24.

**23.** **(c)** $(n + 2)! = 2550\ (n!)$

$\Rightarrow (n + 2)(n + 1)(n!) = 2550(n!)$

$\Rightarrow (n + 2)(n + 1) = 2550$

$\Rightarrow n^2 + 3n + 2 - 2550 = 0$

$\Rightarrow n^2 + 3n - 2548 = 0$

$\Rightarrow n^2 + 52n - 49n - 2548 = 0$

$\Rightarrow n(n + 52) - 49(n + 52) = 0$

$\Rightarrow (n - 49)(n + 52) = 0$

$\Rightarrow n = 49$ or, $n = -52$

$\Rightarrow n = 49$ as $n = -52$ is rejected being $n \varepsilon N$

$\therefore\ n = 49.$

**24.** **(d)** $(n + 1)\,! = 6[(n - 1)!]$

$\Rightarrow (n + 1).\ n.\ [(n - 1)!] = 6[(n - 1)!]$

$\Rightarrow n^2 + n = 6 \Rightarrow n^2 + n - 6 = 0$

$\Rightarrow$ $(n-2)(n+3) = 0$

$\therefore$ Either $n - 2 = 0$ or $n + 3 = 0$

$\Rightarrow$ $n = 2$ or $n = -3$

$n$ being natural number, so $n \neq -3$, $\therefore$ $n = 2$.

**25.** **(a)** $\frac{n!}{2!(n-2)!} : \frac{n!}{4!(n-4)!} = 2:1$

$$\Rightarrow \frac{n!}{2!(n-2)!} \times \frac{4!(n-4)!}{n!} = \frac{2}{1} \Rightarrow \frac{4!(n-4)!}{2!(n-2)!} = 2$$

$$\Rightarrow \frac{4 \times 3 \times 2!}{2!} \times \frac{(n-4)!}{(n-2)(n-3)(n-4)!} = 2$$

$\Rightarrow$ $12 = 2(n-2)(n-3)$

$\Rightarrow$ $6 = n^2 - 5n + 6 \Rightarrow n^2 - 5n = 0$

$\Rightarrow$ $n(n-5) = 0 \Rightarrow n = 0$ or $5$.

**26.** **(c)** ${}^nP_4 = 18 \cdot {}^{n-1}P_2$

$$\Rightarrow \frac{n!}{(n-4)!} = 18 \cdot \frac{(n-1)!}{(n-1-2)!}$$

$$\Rightarrow \frac{n!}{(n-4)!} = 18 \cdot \frac{(n-1)!}{(n-3)!}$$

$$\Rightarrow \frac{n(n-1)!}{(n-4)!} = 18 \cdot \frac{(n-1)!}{(n-3)(n-4)!}$$

$$\therefore \quad n = \frac{18}{n-3}$$

i.e., $n^2 - 3n - 18 = 0 \quad \Rightarrow (n-6)(n+3) = 0$

$\Rightarrow n = 6, -3$

But $n$ cannot be negative

$\therefore$ $n = 6$.

**27.** **(b)** $P(56, r+6):P(54, r+3) = 30800:1$

$$\Rightarrow \frac{56!}{(50-r)!} : \frac{54!}{(51-r)!} = 30800:1$$

$$\Rightarrow \frac{54!.55.56}{(50-r)!} : \frac{54!}{(50-r)!.(51-r)} = 30800:1$$

$$\Rightarrow \frac{3080}{1} : \frac{1}{51-r} = 30800:1$$

$$\Rightarrow 3080\,(51-r) = \frac{30800}{1}$$

$\Rightarrow$ $51 - r = 10 \Rightarrow r = 51 - 10$

$\therefore$ $r = 41$.

**28.** **(a)** The required number of ways = number of permutations of 10 people taking all 10 at a time.

$= P(10, 10) = 10!$

$= 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

$= 3628800$.

**29.** **(c)** The word EQUATION has exactly 8 letters which are all different.

$\therefore$ Number of words that can be formed = number of permutations of 8 letters taken all at a time

$= P(8, 8) = 8!$

$= 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 40320$.

**30.** **(d)** Out of 10 students, the first three prizes can be won in

$${}^{10}P_3 = \frac{10!}{(10-3)!} = \frac{10!}{7!}$$

$= 10 \times 9 \times 8 = 720$ ways.

**31.** **(a)** Total number of candidates = 5 + 4 = 9. In the row of 9 positions, the even places are 2nd, 4th, 6th and 8th. Now, number of even places = 4. Number of women to occupy the even places = 4.

$\therefore$ Even places can be filled = $P(4, 4)$ ways

Number of men = 5

$\therefore$ The remaining 5 places can be filled by 5 men

$= P(5, 5)$ ways

$\therefore$ By the fundamental principle of counting:

$\therefore$ The required number of seating arrangements

$= P(4, 4) \times P(5, 5) = 4! \times 5!$

$= 24 \times 120 = 2880$.

**32.** **(c)** 4 different books can be arranged among themselves, in a shelf, in $P(4, 4)$

$= 4 \times 3 \times 2 \times 1 = 24$ ways.

**33.** **(c)** Wearing 3 different rings in 4 fingers with at most 1 in each finger is equivalent to arranging 3 different objects in 4 places.

This can be done in $P(4, 3) = 4 \times 3 \times 2 = 24$ ways.

**34.** **(a)** There are 4 rows of chairs (say I, II, III, IV) consisting of 8 chairs each. It is desired that in each row, all students belong to the same class and no 2 adjacent rows are allotted to same class.

Therefore, 1 class can be seated in either I and III or in II and IV, that is in 2 ways.

Now, 16 students of this class can be arranged in 16 chairs in ${}^{16}P_{16} = 16!$ ways.

16 students of other class can be arranged in remaining 16 chairs in ${}^{16}P_{16} = 16!$ ways

$\therefore$ Total number of ways = $2 \times 16! \times 16!$.

**35.** **(c)** A number lying between 1000 and 10000 has four places which can be filled up out of 7 digits in ${}^7P_4 = 7 \times 6 \times 5 \times 4 = 840$ ways.

**36.** **(d)** The numbers that can be formed, by taking all 6 digits together

$= {}^6P_6 = 6!$

But we have to neglect the numbers which begin with zero. Now, the numbers in which zero comes in the 1st place = 5!

Hence, the required number = $6! - 5!$

$= 720 - 120 = 600$.

**37.** **(a)** The required number of 3-digit numbers

= The permutations of the 10 objects 0, 1, 2, 3, 4, 5, 6,7, 8, 9, take 3 at a time, with the condition that 0 is not in the hundred's place.

$= P(10, 3) - P(9, 2)$

$= \frac{10!}{7!} - \frac{9!}{7!}$

$= \frac{10 \times 9 \times 8 \times 7!}{7!} - \frac{9 \times 8 \times 7!}{7!}$

$= 10 \times 9 \times 8 - 9 \times 8$

$= 720 - 72 = 648.$

**38.** **(b)** 6 periods can be arranged for 5 subjects in $P(6, 5)$ ways

$= 6 \times 5 \times 4 \times 3 \times 2 = 720$

1 period is left, which can be arranged for any of the 5 subjects.

$\therefore$ 1 left period can be arranged in 5 ways.

$\therefore$ The required number of arrangements

$= 720 \times 5 = 3600.$

**39.** **(b)** The required number of ordered pairs of alphabets, to be used as initials, can be formed $= P(4, 2) = \frac{4!}{2!} = 4 \times 3 = 12.$

**40.** **(a)** Total number of candidates = 8.

5 different subjects candidates can be seated in $P(5, 5) = 5!$ ways.

In between 5 candidates there are six places for 8 Mathematics candidates.

$\therefore$ The Mathematics candidates can be seated in $P(6, 3)$ ways

$\therefore$ By fundamental principle of counting:

The required number of ways $= 5! \times P(6, 3)$

$= 120 \times \frac{6!}{3!}$

$= 120 \times 6 \times 5 \times 4 = 14400.$

**41.** **(a)** The vowels in the word 'ORIENTAL' are: O, I, E and A

Total number of letters in the word 'ORIENTAL' = 8.

Number of vowels = 4

| O | R | I | E | N | T | A | L |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| × | | × | | × | | × | |

$\because$ Vowels occupy odd places, that is 1, 3, 5 and 7. Number of odd places = 4

$\therefore$ 4 vowels can be arranged in 4 '$X$' marked places $= P(4, 4)$ ways $= 4!$ ways

Number of consonants = 4.

$\therefore$ 4 consonants can be arranged in four places

$= P(4, 4)$ ways $= 4!$ ways

$\therefore$ The required number of words

$= 4! \times 4! = 24 \times 24 = 576.$

**42.** **(b)** The numbers are divisible by 10 if 0 is in the unit's place.

× × × × × 0

$\therefore$ The required numbers which are divisible by 10 = $P(5, 5) = 5! = 120.$

**43.** **(b)**

(i) The word 'UNIVERSAL' has 9 letters which are all different. These 9 letters can be arranged amongst themselves in 9! ways.

(ii) 3 letters E, R, S can be taken to form 1 block. Thus, 7 letters U, N, I, V, ERS, A, L can be arranged in 7! ways.

Also, 3 letters E, R, S can be arranged amongst themselves in 3! ways.

$\therefore$ The total number of arrangements $= 7! \times 3! = 30240.$

**44.** **(a)** 5 students are to be arranged on a platform. 1 boy SUNIL is fixed at second position.

$\therefore$ We have to arrange only 4 students. But GITA is always adjacent to NITA. Considering the 2 girls (NITA and GITA) as 1, the 3 students can be arranged in 3! ways. NITA and GITA themselves can be arranged in 2! ways.

$\therefore$ The required number of arrangements

$= 2! \times 3! = (2 \times 1) \times (3 \times 2 \times 1) = 12.$

**45.** **(a)** ALGEBRA has 7 letters where 2 – A, 1 – $L$, 1 – G, 1 – E, 1 – B and 1 – R.

(i) Since two A's are always together, we take both the A's as 1 letter.

If $P$ is the number of arrangements, then

$P = 6! = 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720.$

(ii) Total number of permutations

$q = \frac{7!}{2!} = 7 \times \frac{7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{2 \times 1} = 2520$

In these permutations, in some permutations, two A's are together while in the rest they are not together.

Hence, the number of permutations in which two A's are not together is

$q - p = 2520 - 720 = 1800.$

**46.** **(a)** Each apple can be given to any 1 of the 3 boys and this can be done in 3 ways.

$\therefore$ The required number of ways = $3^6$ = 729.

**47.** **(c)** Number of letters in the word 'KURUKSHETRA' is 11 of which 2 are K's, 2 are U's, 2 are R's and remaining are different.

$\therefore$ Required number of permutations = $\frac{11!}{2!\,2!\,2!}$

= 4989600.

**48.** **(a)** The word ALLAHABAD has 9 letters in all. The letter '*A*' occurs 4 times, the letter '*L*' occurs 2 times and the remaining three letters H, B, D each occur once.

$\therefore$ The require number of permutations

$= \frac{9!}{4!\,2!\,1!\,1!} = \frac{9\times8\times7\times6\times5\times4!}{4!\times2}$

= 9 × 8 × 7 × 3 × 5 = 7560.

**49.** **(b)** There are three places to be filled up to form a 3-digit number. Since any digit may be repeated any number of times, each 1 of three places can be filled up by any of the given 4 digits in 4 ways.

Hence, the number of words that can be formed

= $4^3$ = 64.

**50.** **(c)** There are in all 5 digits. Now, 0 cannot be placed at the hundredth place as in that case the number will not be 3-digited. Thus, hundredth place can be filled up by any of remaining 4 digits in 4 ways.

Since the digits may be repeated any number of times, each of the remaining two places can be filled up by any of the 5 digits in 5 ways each. Thus, the total number of such arrangements = $5^2$ = 25.

Hence, the total number of words that can be formed

= 4 × 25 = 100.

**51.** **(b)** Out of letters in the word 'BHARAT' 2 letters, that is, A's are alike.

$\therefore$ Number of permutations = $\frac{6!}{2!}$ = 360.

Number of words in which B and H are never together

= Total number of words − number of words in which *B* and H are together

$=360 - \frac{5!}{2!}\,.\,2 = 360 - 120 = 240.$

**52.** **(d)** The given word consists of 11 letters out of which A occurs 2 times, R occurs 2 times, N occurs 2 times and E occurs 2 times and remaining 3 are different.

$\therefore$ Number of arrangements

$= \frac{11!}{2!\,2!\,2!\,2!} = 2491800.$

**53.** **(b)** Starting with *A* and arranging the other ten letters A, E, I, I, M, N, N, O, T, X (not all distinct, I occurs twice, N occurs twice), there are

$\frac{10!}{2!\,2!} = \frac{10\times9\times8\times7\times6\times5\times4\times3\times2\times1}{2\times2}$

= 907200 words.

$\therefore$ The number of items in the list before the first word starting with E is 907200.

**54.** **(c)** The 5-digit even numbers can be formed out of 1, 2, 5, 5, 4 by using either 2 or 4 in the unit's place. This can be done in 2 ways.

Corresponding to each such arrangement, the remaining four places can be filled up by any of the remaining 4 digits in $\frac{4!}{2!}$ = 12 ways.

[$\because$ 50 occurs twice]

Hence, the total number of words = 2 × 12 = 24.

**55.** **(a)** A number greater than a million has seven places, and thus all the 7 given digits are to be used. But 2 is repeated twice and 3 is repeated thrice.

$\therefore$ Total number of ways of arranging these 7 digits amongst themselves

$= \frac{7!}{2!3!} = 420$

But numbers beginning with zero are no more 7 digited numbers, hence we have to reject those numbers which begin with zero, and such numbers are

$= \frac{6!}{2!.3!} = 60.$

Hence, the required number of arrangements,

= 420 − 60 = 360.

**56.** **(d)** There are 7 letters, of which 2 are A's and the rest are all different. The vowels A, A, E occupy 1st, 4th and 7th places. The number of ways in which they can be arranged in these places is $\frac{3!}{2!}$ = 3.

The consonants L, G, B, R are all different. The number of ways in which they can be arranged in the remaining places in 4!. Since each way of arranging the vowels can be *associated* with each way of arranging the consonants, we find that the total number of arrangements = 3 × 4!, = 3 × 24 = 72.

**57.** **(a)** There are in all 7 letters in the word BALLOON in which L occurs 2 times and O occurs 2 times.

$\therefore$ The number of arrangements of the 7 letters of the word = $\frac{7!}{2!\times2!}$ = 1260.

If two *L*'s always come together, taking them as 1 letter, we have to arrange 6 letters in which O occurs 2 times.

$\therefore$ The number of arrangements in which the two *L*'s come together

$= \frac{6!}{2!} = 6\times5\times4\times3 = 360.$

Hence, the required number of ways in which the two $L$'s do not come together

$= 1260 - 360 = 900.$

**58.** **(d)** Here, $n = 3 + 2 + 2 = 7$

$p_1 = 3, p_2 = 2$ and $p_3 = 2$

$\therefore$ The required number of different signals

$$= \frac{n!}{p_1!\,p_2!\,p_3!} = \frac{7!}{3!\,2!\,2!} = \frac{7.6.5.4}{2.2}$$

$= 7.6.5 = 210.$

**59.** **(c)** The given digits are: 1, 2, 3, 4, 3, 2, 1. Out of these 1, 3, 3, 1 are odd digits.

The odd digits occupy the odd places, that is, they occupy the 1st, 3rd, 5th and 7th place.

$\therefore$ 4 odd places can be filled with 4 odd digits

$$= \frac{4!}{2!\,2!} = \frac{4.3}{2} = 6 \text{ ways.}$$

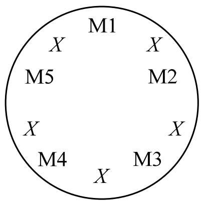
The three even places to be filled with the even digits 2, 4, 2.

These places can be filled $= \dfrac{3!}{2!1!} = \dfrac{3.2!}{2!} = 3$ ways

Hence, the required number of numbers

$= 6 \times 3 = 18.$

**60.** **(b)** Refer to Fig. Let, us first seat 5 gentlemen on the round table and this can be done in $(5 - 1)! = 24$ ways.




Since no 2 ladies are to sit together, they can occupy the places marked as '$X$'

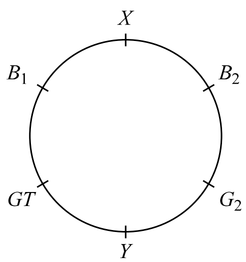
Number of '$X$' signs = 5

$\therefore$ 4 ladies can be arranged in five places in

$${}^5P_4 = \frac{5!}{1!} = 120 \text{ ways.}$$

$\therefore$ Required number of ways $= 24 \times 120 = 2880.$

**61.** **(b)** Let, $B_1$, $B_2$ and $X$ be 3 boys and $G_1$, $G_2$, $Y$ be 3 girls. Since $X$ does not want any girl neighbour, $B_1$, $B_2$ can be their neightbours.




Similarly, the girl $Y$ does not want any boy neighbour, therefore $G_1$, $G_2$ are the only neighbours of $Y$. Now, $B_1$, $B_2$ can arrange themselves in 2! ways and $G_1$, $G_2$ can also arrange themselves in 2! ways.

Hence, the required number of permutations

$= 2! \times 2! = 4.$

**62.** **(c)** $n$ = Total number of beads $= 6 + 5 = 11$

$P_1 = 6$, $P_2 = 5$

$\therefore$ Number of different necklaces

$$= \frac{1}{2}\frac{(11-1)!}{6!\,5!} = \frac{10!}{2.6!\,5!}$$

$$= \frac{10.9.8.7.6!}{2.6!.5.4.3.2.1} = 3 \times 7 = 21.$$

**63.** **(a)** Treat the Punjab and Madras Chief Ministers as one then we have (P, M) + 9 others.

$\therefore$ We have to arrange 10 persons round a table. This can be done in $(10 - 1)! = 9!$ ways.

Corresponding to each of these 9! ways, the Punjab and Madras Chief Ministers can interchange their places in 2! ways. Associating the 2 operations, total number of ways

$= 9!\,2! = (9.8.7.6.4.3.2.1)\,(2.1) = 725760.$

**64.** **(b)** We know that $C(n, r) = \dfrac{n!}{r!(n-r)!}$.

Now, $C(n, 7) = C(n, 5)$

$\Rightarrow \dfrac{n!}{7!(n-7)!} = \dfrac{n!}{5!(n-5)!}$

$\Rightarrow 5!(n - 5)! = 7!(n - 7)!$

$\Rightarrow [5!].(n - 5)(n - 6)[(n - 7)!] = 7.6.[5!](n - 7)!$

$\Rightarrow n^2 - 11n + 30 = 42$

$\Rightarrow n^2 - 11n + 30 - 42 = 0$

$\Rightarrow n^2 - 11n - 12 = 0$

$\Rightarrow (n - 12)(n + 1) = 0$

$\Rightarrow n - 12 = 0$ or, $n + 1 = 0$

$\Rightarrow n = 12$ or, $n = -1$.

But $n = -1$ is rejected as $n$ is a non-negative integer,

$\therefore\ n = 12.$

**65.** **(a)** $C(n, 8) = C(n, 6)$

$\Rightarrow \dfrac{n!}{8!(n-8)!} = \dfrac{n!}{6!(n-6)!}$

$\Rightarrow 6!(n - 6)! = 8!(n - 8)!$

$\Rightarrow 6!(n - 6)(n - 7)[(n - 8)!] = 8.7.6!(n - 8)!$

$\Rightarrow n^2 - 13n + 42 = 56$

$\Rightarrow n^2 - 13n + 42 - 56 = 0$

$\Rightarrow n^2 - 13n - 14 = 0$

$\Rightarrow n^2 - 13n - 14 = 0$

$\Rightarrow (n - 14)(n + 1) = 0$

$\Rightarrow n - 14 = 0$ or $n + 1 = 0$

$\Rightarrow$ $n = 14$ or $n = -1$.

But $n = -1$ is rejected as $n$ is a non-negative integer

$\Rightarrow$ $n = 14$

$\therefore$ $C(n, 2) = C(14, 2) = \dfrac{14!}{2!12!} = \dfrac{14.13.12!}{2.12!}$

$= 91$.

**66.** **(a)** $C(2n, 3):(C, 3) = 11:1$

$\Rightarrow$ $\dfrac{(2n)!}{3!(2n-3)!} : \dfrac{n!}{3!(n-3)!} = 11:1$

$\Rightarrow$ $(2n)(2n-1)(2n-2) : n(n-1)(n-2) = 11 : 1$

$\Rightarrow$ $2 \times 2(2n-1)(n-1) : (n-1)(n-2) = 11 : 1$

$\Rightarrow$ $4(2n-1) : n-2 = 11:1$

$\Rightarrow$ $\dfrac{8n-4}{n-2} = \dfrac{11}{1}$

$\Rightarrow$ $11n - 22 = 8n - 4$

$\Rightarrow$ $11n - 8n = 22 - 4$

$\Rightarrow$ $3n = 18$ $\therefore$ $n = 6$.

**67.** **(a)** ${}^{2n}C_r = {}^{2n}C_{2n-r}$ $\quad [\because {}^nC_r = {}^nC_{n-r}]$

But ${}^{2n}C_r = {}^{2n}C_{r+2}$ [Given]

$\therefore$ ${}^{2n}C_{2n-r} = {}^{2n}C_{r+2}$

$\therefore$ $2n - r = r + 2 \Rightarrow r = n - 1$.

**68.** **(a)** ${}^{18}C_r = {}^{18}C_{18-r}$ $\quad [\because {}^nC_r = {}^nC_{n-r}]$

But ${}^{18}C_r = {}^{18}C_{r+r}$ [Given]

$\therefore$ ${}^{18}C_{18-r} = {}^{18}C_{r+2}$ or, $18 - r = r + 2 \Rightarrow r = 8$

$\therefore$ ${}^rC_5 = {}^8C_5 = \dfrac{8!}{5!3!} = \dfrac{8\times7\times6\times5!}{3\times2\times1\times5!} = 56$.

**69.** **(b)** Here, $12 \cdot {}^nC_2 = {}^{2n}C_3$

$\therefore$ $12 \cdot \dfrac{n!}{2!(n-2)!} = \dfrac{(2n)!}{3!(2n-3)!}$ $\quad \left[\because {}^nC_r = \dfrac{n!}{r!(n-r)!}\right]$

or, $12 \cdot \dfrac{n(n-1)(n-2)!}{2!.(n-2)!} = \dfrac{(2n)(2n-1)(2n-2)(2n-3)!}{6(2n-3)!}$

or, $6 \cdot n(n-1) = \dfrac{2n(2n-1)(2n-2)}{6}$

or, $18 \cdot (n-1) = (2n-1)(2n-2)$

or, $9 \cdot (n-1) = (2n-1)(n-1)$

i.e., $9 = 2n - 1 \Rightarrow n = 5$.

**70.** **(b)** $\sum_{r=1}^{5} C(5, r) = C(5, 1) + C(5, 2) + C(5, 3) + C(5, 4) + C(5, 5)$

$= \dfrac{5!}{1!4!} + \dfrac{5!}{2!3!} + \dfrac{5!}{3!2!} + \dfrac{5!}{4!1!} + \dfrac{5!}{5!0!}$

$= \dfrac{5}{1} + \dfrac{5.4}{2} + \dfrac{5.4}{2} + \dfrac{5}{1} + 1$

$= 5 + 10 + 10 + 5 + 1 = 31$.

**71.** **(c)** The require number of ways $= C(10, 5)$

$= \dfrac{10!}{5!5!} = \dfrac{10.9.8.7.6}{5.4.3.2} = 3.2.42 = 252$.

**72.** **(d)** 11 players can be selected out of 16 players in ${}^{16}C_{11}$ ways $= \dfrac{16!}{11!5!} = 4368$ ways.

When 2 particular players are always to be included, then 9 more players are to be selected out of remaining 14 players, which can be done in

${}^{14}C_9$ ways $= \dfrac{14!}{9!5!} = 2002$ ways.

**73.** **(b)** 11 players can be selected out of 16 players in ${}^{16}C_{11}$ ways $= \dfrac{16!}{11!5!} = 4368$ ways.

If 1 particular player is to be excluded, then selection is to be made of 11 players out of 15 players and this can be done in ${}^{15}C_{11}$ ways

$= \dfrac{15!}{11!4!} = 1365$ ways.

**74.** **(a)** 11 players can be selected out of 16 players in ${}^{16}C_{11}$ ways $= \dfrac{16!}{11!5!} = 4368$ ways

If 2 particular players are to be included and one particular player is to be rejected, then we have to select 9 more out of 13 in ${}^{13}C_9$ ways

$= \dfrac{13!}{9!4!} = 715$ ways.

**75.** **(d)** The required number of ways

$= C(10, 8) . C(10, 5)$

$= \dfrac{10!}{8!2!} \times \dfrac{10!}{5!5!} = \dfrac{10\times9}{2} \times \dfrac{10\times9\times8\times7\times6}{5\times4\times3\times2}$

$= 5 \times 9 \times 3 \times 2 \times 7 \times 6 = 11340$.

**76.** **(c)** Here, we want to find the number of ways of selecting 11 players out of 15.

$\therefore$ The required number of ways

$= C(15, 11) = \dfrac{15!}{11!4!} = \dfrac{15\times14\times13\times12}{4\times3\times2\times1}$

$= 15 \times 7 \times 13 = 1365$.

A particular player to be included

So, we have to select 10 players out of 14.

$\therefore$ The required number of ways

$= C(14, 10) = \dfrac{14!}{10!4!} = \dfrac{14.13.12.11}{4.3.2.1} = 7.13.11 = 1001$.

**77.** **(c)** Number of letters in the word = 8

Number of vowels in the word = 4

(1, O, U, E)

Number of consonants in the word = 4

(N, V, L, T)

Out of 4 vowels, we have to select 3.

Out of 4 consonants, we have to select 2.

Also, we have to arrange 3 vowels and 2 consonants.

$\therefore$ The required number of words

$= C(4, 3).C(4, 2).5! = 4 \times \dfrac{4\times 3}{2} = 120 = 2880.$

**78.** **(b)** We get a line by joining 2 points. If $p$ is the number of lines from 21 points, then,

$p = C(21, 2) = \dfrac{21!}{2!(21-2)!} = \dfrac{21\times 20(19!)}{2\times 1(19!)} = 21 \times 10 = 210$

lines.

**79.** **(c)** If $p$ is the required number of ways, then

$p = C(6, 3) \times C(5, 3) \times C(5, 3)$

$= \dfrac{6!}{3!(6-3)!} \times \dfrac{5!}{3!(5-3)!} \times \dfrac{5!}{3!(5-3)!}$

$= \dfrac{6\times 5\times 4\times 3!}{3\times 2\times 1\times 3!} \times \dfrac{5\times 4\times 3!}{2\times 1\times 3!} \times \dfrac{5\times 4\times 3!}{2\times 1\times 3!}$

$= 5 \times 4 \times 5 \times 2 \times 5\times 2 = 2000.$

**80.** **(b)** Out of available 9 courses, two are compulsory. Hence, the student is free to select 3 courses out of 7 remaining courses: If $p$ is the number of ways of selecting 3 courses out of 7 courses, then

$p = C(7, 3) = \dfrac{7!}{3!(7-3)!} = \dfrac{7!}{3!\,4!} = \dfrac{7\times 6\times 5\times 4!}{3\times 2\times 1\times 4!}$

$= 7 \times 5 = 35$ ways.

**81.** **(c)** If $p$ is the number of ways of selection, then

$p = C(6, 4) \times C(7, 4) \times (8, 4) = \dfrac{6!}{4!\,2!} \times \dfrac{7!}{4!\,3!} \times \dfrac{8!}{4!\,4!}$

$= \dfrac{6\times 5\times 4!}{2\times 1\times 4!} \times \dfrac{7\times 6\times 5\times 4!}{3\times 2\times 1\times 4!} \times \dfrac{8\times 7\times 6\times 5\times 4!}{4\times 3\times 2\times 1\times 4!}$

$= 15 \times 35 \times 70 = 36750$ ways.

**82.** **(c)** If A and B both are not selected, then the number of permutations $= C(6, 6) = 1$.

If A and B both are selected, then we are to select 4 persons out of 6 persons.

The number of ways in which this can be done

$= C(6, 4) = \dfrac{6!}{4!(6-2)!} = \dfrac{6\times 5\times 4!}{4!\times 2\times 1} = 15$

Hence, total number of permutations = 1 + 15 = 16.

## Exercise-2
## (Based on Memory)

**1.** **(b)** Required different ways = ${}^7P_7$

$= \lfloor 7 = 5040$

**2.** **(a)** Required number of ways = 8! = 40320

**3.** **(a)** Required number of ways = 6! = 720

**4.** **(a)** Required number of ways

$= {}^{10}C_3 \times {}^8C_2 = 120 \times 28 = 3360$

**5.** **(e)** Required number of ways

$= {}^8C_4 \times {}^{10}C_0 + {}^8C_3 \times {}^{10}C_1 + {}^8C_2 \times {}^{10}C_2$

= 70 + 560 + 1200 = 1890

**6.** **(b)** Required number of ways

$= {}^5C_2 \times {}^3C_2 \times {}^5C_1 = 10 \times 3 \times 5 = 150$

**7.** **(a)** Required number of ways

$= {}^{18}C_7 = \dfrac{18\times 17\times 16\times 15\times 14\times 13\times 12}{7\times 6\times 5\times 4\times 3\times 2}$

= 31824

**8.** **(c)** Required number of ways $= {}^5C_3 = 10$

**9.** **(a)** Required number of ways $= \dfrac{7!}{3!} = 840$

**10.** **(b)** A first, 3 persons can be selected from 6 persons in

${}^6C_3 = \dfrac{6!}{3!3!} = 20$ ways.

Now, 3 selected persons can sit in 3! = 6 ways.

$\therefore$ Total number of required ways

$= 20 \times 6 = 120$

**11.** **(d)** Required number of ways

$$^9C_5 = \frac{9!}{5!(9-5)!} = \frac{6\times7\times8\times9}{2\times3\times4} = 126$$

**12.** **(d)** The required number of ways $= \frac{7!}{3!} = 840$

**13.** **(e)** Required number of ways = 6! = 720

**14.** **(b)** Required number of ways

= 5! = 5 × 4 × 3 × 2 × 1 = 120

**15.** **(c)** Required number of ways $= \frac{7!}{2!} = 2520$

**17.** **(b)** Total different ways of sitting

$= {}^4P_4 \times {}^2P_2 = \lfloor 4 \times \lfloor 2 = 48$

**18.** **(a)** Required number of ways = 6! = 720

**19.** **(c)** Required different ways

$= \lfloor 3 \times \lfloor 4 = 6 \times 24 = 144$

**20.** **(a)** Required different ways

$= {}^7C_3 - {}^3C_3 = \frac{\lfloor 7}{\lfloor 3 \lfloor 4} - \frac{\lfloor 3}{\lfloor 0 \lfloor 3} = 34$

**21.** **(a)** Let, the probability of truth spoken by A and B be $p_1$ and $p_2$, respectively

$\therefore \quad p_1 = \frac{3}{4}$ and $p_2 = \frac{4}{5}$

They will contradict each other only when 1 speaks truth and the other is lying

i.e., $\frac{3}{4}\times\frac{1}{5}+\frac{4}{5}\times\frac{1}{4} = \frac{3}{20}+\frac{4}{20} = \frac{7}{20} = \frac{35}{100}$, i.e., 35%

**22.** **(e)** If the ball drawn is neither red nor green, then it must be blue, which can be picked in $^7C_1$ = 7 ways. 1 ball can be picked from the total (8 + 7 + 6 = 21) is $^{21}C_1$ = 21 ways.

$\therefore$ Required probability $= \frac{7}{21} = \frac{1}{3}$.

**23.** **(d)** There are 6 letters in the word 'ATTEND' whereas, $T$ comes 2 times.

So, required number of ways $= \frac{6!}{2!} = \frac{720}{2} = 360$

**24.** **(d)** CYCLE whereas C comes two times.

So, arrangements are $= \frac{5!}{2!} = \frac{5\times4\times3\times2}{2}$ = 60 ways

**25.** **(a)** The word DESIGN be arranged so that the vowels are at 2 ends then the required number of orders

$= {}^2P_2 \times {}^4P_4$

= 2! × 4!

= 2 × 4 × 3 × 2

= 48

**26.** **(d)** There are 5 letters in the word SMART.

So, the required number of ways to arrange

$= {}^5P_5 = 5!$

= 5 × 4 × 3 × 2 × 1

= 120

**27.** **(d)** Total number of letters is 7, and these letters can be arranged in 7! ways

= 1 × 2 × 3 × 4 × 5 × 6 × 7 = 5040 ways.

There are 7 letters in the world THERAPY including 2 vowels. (E, A) and 5 consonants.

Consider 2 vowels as 1 letter.

We have 6 letters which can be arranged in $^6P_6$ = 6 ways.

But vowels can be arranged in 2! Ways.

Hence, the number of ways, all vowels will come together = 6! × 2!

= 1 × 2 × 3 × 4 × 5 × 6 × 2 = 1440

Total number of ways in which vowels will never come together = 5040 – 1440 = 3600

**28.** **(a)** 6 letters of the word PRAISE can be arranged in 6!ways= 720 ways.

**29.** **(a)** Required number of ways

$= \lfloor 6 = 6\times5\times4\times3\times2\times1 = 720$

**30.** **(d)** Required number of ways $= \frac{7!}{2!} = 2520$

**31.** **(c)** Total number of students = 54 × 30

When arranged in rows of 45, number of rows

$= \frac{54\times30}{45} = 36$

**32.** **(e)** Required number of arrangements $= \frac{6!}{2!}$

$= \frac{6\times5\times4\times3\times2}{2} = 360$

**33.** **(a)** Number of combinations

$= {}^4C_4 \times {}^6C_1 + {}^3C_3 \times {}^4C_2$

= 1 × 6 + 1 × 6

= 12.

**34.** **(c)** Number of combinations

= selecting 2 trainees out of of 3 and selecting 3 Research Associates out of 6

$= {}^3C_2 \times {}^6C_3 = 3 \times \frac{6 \times 5 \times 4}{1 \times 2 \times 3} = 60$

**35.** **(a)** Required number of ways $= \frac{7!}{2!} = 2520$

**36.** **(a)** Required number of ways

$= {}^5c_2 \times {}^6c_2 \times {}^3c_1 = 450$

**37.** **(d)** Required number of ways

$= {}^3c_3 \times {}^{11}c_2 = 1 \times \frac{10 \times 11}{2} = 55$

**38.** **(c)** Number of groups formed = 2

Number of ways boys could be arranged = 4!

Number of ways girls could be arranged = 3!

Required number of ways = 2 × 4! × 3!

**39.** (e) Required number of ways $= \frac{5!}{2!} = 60,$

Total number of letters in the word is 5; T is repeated twice.

**40** **(e)** N is repeated twice.

Hence the required answer will be $\frac{\lfloor 7}{2} = 2520.$

**41.** (e) Required number of selections $= {}^8c_1 \times {}^7c_5 = 168$

# Probability

# 32

## INTRODUCTION

The word *probability* or *chance* is very frequently used in day-to-day life. For example, we generally say, 'He may come today' or 'probably it may rain tomorrow' or 'most probably he will get through the examination'. All these phrases involve an element of uncertainty and probability is a concept which measures this uncertainties. The probability when defined in simplest way is the chance of occurring of a certain event when expressed quantitatively, i.e., probability is a quantitative measure of the certainty.

The probability has its origin in the problems dealing with games of chance such as gambling, coin tossing, die throwing and playing cards. In all these cases the outcome of a trial is uncertain. These days probability is widely used in business and economics in the field of predictions for future.

The following remarks may be important for learning this chapter on probability.

1. **Die:** A die is a small cube used in games of chance. On its 6 faces dots are marked as
   . .. ... ∷ ⁙ ⋮⋮
   Plural of die is dice. The outcome of throwing (or tossing) a die is the number of dots on its uppermost face. An ace on a die means 1 dot.
2. **Cards:** A pack (or deck) of playing cards has 52 cards, divided into 4 suits:
   (i) Spades हुकम (♠) (ii) Clubs चिडी (♣)
   (iii) Hearts पान (♥) (iv) Diamonds ईंट (♦)
   Each suit has 13 cards, nine cards numbered 2 to 10, an Ace (इक्का), a King (बादशाह), Queen (बेगम) and a Jack or Knave (गुलाम). Spades and Clubs are black-faced cards while Hearts and Diamonds are red-faced cards. The Aces, Kings, Queens and Jacks are called *face cards* and other cards are called *number cards*. The Kings, Queens and Jacks are called *court cards*.
3. The number of combinations of $n$ objects taken $r$ at a time ($r \le n$) is denoted by $C(n, r)$ or $^nC_r$ and is defined as

$$^nC_r = \frac{n!}{r!(n-r)!} = \frac{n(n-1)(n-2)\ldots\text{to } r \text{ factors}}{1\cdot 2\cdot 3 \ldots r}.$$

**Illustration 1:** $^5C_3 = \dfrac{5\cdot 4\cdot 3}{1\cdot 2\cdot 3} = 10$, $^nC_0 = 1$ and $^nC_n = 1$.

If $r > \dfrac{n}{2}$, then it is better to simplify $^nC_r$ as $^nC_{n-r}$.

**Illustration 2:** $^{52}C_{50} = {}^{52}C_{52-50} = {}^{52}C_2 = \dfrac{52.51}{2.1}$

$= 26.51 = 1326.$

When, $r>n$, $^nC_r = 0$.

### Some Important Terms and Concepts

**Random Experiment or Trial:** The performance of an experiment is called a *trial*. An experiment is characterised by the property that its observations under a given set of circumstances do not always lead to the same observed outcome but rather to the different outcomes. If in an experiment all the possible outcomes are known in advance and none of the outcomes can be predicted with certainity, then such an experiment is called a *random experiment*.

For example, tossing a coin or throwing a die are random experiments.

**Event:** The possible outcomes of a trial are called *events*. Events are generally denoted by capital letters $A$, $B$, $C$ and so on.

**Illustration 3:**

(i) When a coin is tossed the outcome of getting a head or a tail is an event.

(ii) When a die is thrown the outcome of getting 1 or 2 or 3 or 4 or 5 or 6 is an event.

**Sample Space:** The set of all possible outcomes of an experiment is called a *sample space*. We generally denote it by $S$.

**Illustration 4:**

(i) When a coin is tossed, $S$ = {H, T} where H = head, T = tail.

(ii) When a die is thrown, $S$ = {1, 2, 3, 4, 5, 6}.

(iii) When 2 coins are tossed simultaneously,

$S$ = {HH, HT, TH, TT}

**Equally Likely Events:** Events are said to be *equally likely* if there is no reason to expect any one in preference to other. Thus, equally likely events mean outcome is as likely to occur as any other outcome.

**Illustration 5:** In throwing a die, all the 6 faces (1, 2, 3, 4, 5, 6) are equally likely to occur.

## Simple and Compound Events

In the case of *simple events* we consider the probability of happening or non-happening of single events.

**Illustration 6:** We might be interested in finding out the probability of drawing an ace from a pack of cards.

In the case of *compound events* we consider the joint occurrence of two or more events.

**Illustration 7:** If from a bag, containing 8 red and 5 green balls, two successive draws of 2 balls are made, we shall be finding out the probability of getting 2 red balls in the first draw and 2 green balls in the second draw. We are thus dealing with a compound event.

**Exhaustive Events:** It is the total number of all possible outcomes of any trial.

**Illustration 8:**

(i) When a coin is tossed, either head or tail may turn up and therefore, there are two exhaustive cases.

(ii) There are six exhaustive cases or events in throwing a die.

(iii) If two dice are thrown simultaneously, the possible outcomes are:

| | | | | | |
|---|---|---|---|---|---|
| (1, 1) | (2, 1) | (3, 1) | (4, 1) | (5, 1) | (6, 1) |
| (1, 2) | (2, 2) | (3, 2) | (4, 2) | (5, 2) | (6, 2) |
| (1, 3) | (2, 3) | (3, 3) | (4, 3) | (5, 3) | (6, 3) |
| (1, 4) | (2, 4) | (3, 4) | (4, 4) | (5, 4) | (6, 4) |
| (1, 5) | (2, 5) | (3, 5) | (4, 5) | (5, 5) | (6, 5) |
| (1, 6) | (2, 6) | (3, 6) | (4, 6) | (5, 6) | (6, 6) |

Thus, in this case, there are $36(=6^2)$ ordered pairs. Hence, the number of exhaustive cases in the simultaneous throw of two dice is 36.

(iv) Three dice are thrown, the number of exhaustive cases is $6^3$, i.e., 216.

## Algebra of Events

If $A$ and $B$ are two events associated with sample space $S$, then

(i) $A \cup B$ is the event that either $A$ or $B$ or both occur.

(ii) $A \cap B$ is the event that $A$ and $B$ both occur simultaneously.

(iii) $\bar{A}$ is the event that $A$ does not occur.

(iv) $\bar{A} \cap \bar{B}$ is an event of non-occurrence of both $A$ and $B$, i.e., none of the events $A$ and $B$ occurs.

**Illustration 9:** In a single throw of a die, let $A$ be the event of getting an even number and $B$ be the event of getting a number greater than 2. Then,

$$A = \{1, 3, 5\}, B = \{3, 4, 5, 6\}$$

$$\therefore \quad A \cup B = \{1, 3, 4, 5, 6\}$$

$A \cup B$ is the event of getting an odd number or a number greater than 2.

$$A \cap B = \{3, 5\}.$$

$A \cap B$ is the event of getting an odd number greater than 2.

$\bar{A}$ = {2, 4, 6} [Those elements of $S$ which are not in $A$.]

$\bar{A}$ is the event of not getting an odd number, i.e., getting an even number.

$$\bar{B} = \{1, 2\}.$$

$\bar{B}$ is the event of not getting a number greater that 2, i.e., getting a number less than or equal to 2.

$$\bar{A} \cap \bar{B} = \{2\}.$$

$\bar{A} \cap \bar{B}$ is the event of neither getting an odd number nor a number greater than 2.

## Mutually Exclusive Events

In an experiment, if the occurrence of an event precludes or rules out the happening of all the other events in the same experiment.

**Illustration 10:**

(i) When a coin is tossed either head or tail will appear. Head and tail cannot appear simultaneously. Therefore, occurrence of a head or a tail are two mutually exclusive events.

(ii) In throwing a die all the 6 faces numbered 1 to 6 are mutually exclusive since if any one of these faces comes, the possibility of others in the same trial, is ruled out.

***Note:***

$A$ and $B$ are mutually exclusive events $\Leftrightarrow A \cap B = \phi$, i.e., $A$ and $B$ are disjoint sets.

**Illustration 11:**

(i) If the random experiment is '*a* die is thrown' and $A$, $B$ are the events, $A$: the number is less than 3; $B$: the number is more than 4, then $A = \{1, 2\}$, $B = \{5, 6\}$. $A \cap B = \phi$, thus $A$ and $B$ are mutually exclusive events.

(ii) If the random experiment is '*a* card is drawn from a well-shuffled pack of cards' and $A$, $B$ are the events

$A$: the card is Black; $B$: the card is an ace.

Since a black card can be an ace, $A \cap B \neq \phi$, thus $A$ and $B$ are not mutually exclusive events.

### Mutually Exclusive and Exhaustive Events

Events $E_1$, $E_2$, ..., $E_n$ are called mutually exclusive and exhaustive if $E_1 \cup E_2 \cup ... \cup E_n = S$, i.e., $\bigcup_{i=1}^{n} E_i = S$ and $E_i \cap E_j = \phi$ for all $i \neq j$.

For example, in a single throw of a die, let $A$ be the event of getting an even number and $B$ be event of getting odd numbers, then

$$A = \{2, 4, 6\},\ B = \{1, 3, 5\}$$
$$A \cap B = \phi,\ A \cup B = \{1, 2, 3, 4, 5, 6\} = S$$

$\therefore$ $A$ and $B$ are mutually exclusive and exhaustive events.

**Illustration 12:** Two dice are thrown and the sum of the numbers which come up on the dice noted. Let us consider the following events:

$A$: 'the sum is even'
$B$: 'the sum is a multiple of 3'
$C$: 'the sum is less than 4'
$D$: 'the sum is greater than 11'

Which pairs of these events are mutually exclusive?

**Solution:** There are $6 \times 6 = 36$ elements in the sample space (Refer to Example 2).

A is the event "the sum is even". It means we have to consider those ordered pairs $(x, y)$ in which $(x + y)$ is even. Thus,

$A$ = [(1, 1), (2, 2) (1, 3), (1, 5), (2, 4), (2, 6), (3, 1), (3, 3), (3, 5), (4, 2), (4, 4), (4,6) (5, 1), (5, 3), (5, 5), (6, 2), (6, 4), (6, 6)].

Similarly,

$B$ = [(1, 2), (2, 1), (1, 5), (5, 1), (3, 3), (2, 4), (4, 2), (3, 6), (6,3), (4,5), (5, 4), (6, 6)]

$C$ = [(1, 1), (2, 1), (1, 2)] $D$ = [(6, 6)].

We find that $A \cap B$ = [(1, 5), (2, 4), (3, 3), (4, 2), (5, 1), (6, 6)] $\neq \phi$

Thus, $A$ and $B$ are not mutually exclusive.

Similarly, $A \cap C \neq \phi$, $A \cap D \neq \phi$, $B \cap C \neq \phi$, $B \cap D \neq \phi$, $C \cap D = \phi$. Thus, $C$ and $D$ are mutually exclusive.

## PROBABILITY OF AN EVENT

The probability of an event is defined in the following two ways:

(i) Mathematical (or *a priori*) definition
(ii) Statistical (or empirical) definition.

**Mathematical Definition of Probability:** Probability of an event $A$, denoted as $P(A)$, is defined as

$$P(A) = \frac{\text{Number of cases favourable to } A}{\text{Number of possible outcomes}}$$

Thus, if an event $A$ can happen in $m$ ways and fails (does not happen) in $n$ ways and each of $m + n$ ways is equally likely to occur then the probability of happening of the event $A$ (also called success of $A$) is given by

$$P(A) = \frac{m}{m+n}$$

and that the probability of non-occurrence of the $A$ (also called its failure) is given by

$$P(\text{not } A) \text{ or } P(\bar{A}) = \frac{n}{m+n}$$

If the probability of the happening of a certain event is denoted by $p$ and that of not happening by $q$, then

$$p + q = \frac{m}{m+n} + \frac{n}{m+n} = 1.$$

Here, $p$, $q$ are non-negative and cannot exceed unity, i.e., $0 \le p \le 1$ and $0 \le q \le 1$.

When $p = 1$, then the event is certain to occur.

When $p = 0$, then the event is impossible. For example, the probability of throwing eight with a single die is zero.

Probability as defined above is sometimes called **Priori Probability,** i.e., it is determined before hand, that is, before the actual trials are made.

**Illustration 13:** A coin is tossed once. What are all possible outcomes? What is the probability of the coin coming up 'tails'?

**Solution:** The coin can come up either "heads" (H) or "tails" (T). Thus, the set $S$ of all possible outcomes is $S$ = {H, T}

$$\therefore \quad P(T) = \frac{1}{2}$$

**Illustration 14:** What is the probability of getting an even number in a single throw of a die?

**Solution:** Clearly, a die can fall with any of its faces upper most. The number on each of the faces is, therefore, a possible outcome. Thus, there are total 6 outcomes. Since there are 3 even numbers on the die, namely, 2, 4 and 6,

$$P(\text{even number}) = \frac{3}{6} = \frac{1}{2}.$$

**Illustration 15:** What is the probability of drawing a 'king' from a well-shuffled deck of 52 cards?

**Solution:** Well-shuffled ensures equally-likely outcomes. There are 4 kings in a deck. Thus,

$$P(\text{a king}) = \frac{4}{52} = \frac{1}{13}.$$

### Odds of an Event

Suppose, there are $m$ outcomes favourable to a certain event and $n$ outcomes unfavourable to the event in a sample space, then odds in favour of the event

$$= \frac{\text{Number of favourable outcomes}}{\text{Number of unfavourable outcomes}} = \frac{m}{n}$$

and odds against the event

$$= \frac{\text{Number of unfavourable outcomes}}{\text{Number of favourable outcome}} = \frac{n}{m}.$$

If odds in favour of an event $A$ are $a:b$, then the probability of happening of event $A = P(A) = \frac{a}{a+b}$ and probability of not happening of event $A = P(\bar{A}) = \frac{b}{a+b}$.

If odds against happening of an event $A$ are $a:b$, then probability of happening of event $A = P(A) = \frac{b}{a+b}$ and probability of not happening of event$A = P(\bar{A}) = \frac{a}{a+b}$.

**Illustration 16:** What are the odds in favour of getting a '3' in a throw of a die? What are the odds against getting a '3'?

**Solution:** There is only one outcome favourable to the event "getting" a 3, the other five outcomes, namely, 1, 2, 4, 5, 6 are unfavourable. Thus,

Odds in favour of getting a '3'

$$= \frac{\text{Number of favourable outcomes}}{\text{Number of unfavourable outcomes}}$$

$$= \frac{1}{5} \text{ or } 1 \text{ to } 5.$$

Odd against getting a '3'

$$= \frac{\text{Number of unfavourable outcomes}}{\text{Number of favourable outcomes}}$$

$$= \frac{5}{1} \text{ or } 5 \text{ to } 1.$$

**Illustration 17:** If the odds in favour of an event are 4 to 5, find the probability that it will occur.

**Solution:** The odds in favour of the event are $\frac{4}{5}$. Thus,

$$\frac{P(A)}{1-P(A)} = \frac{4}{5}, \text{ i.e., } 4[1-P(A)] = 5P(A),$$

i.e., $P(A) = \frac{4}{9}$.

The probability that it will occur $= \frac{4}{9}$.

## FUNDAMENTAL THEOREMS ON PROBABILITY

**Theorem 1:** In a random experiment, if $S$ is the sample space and $E$ is an event, then

(i) $P(E) \geq 0$ (ii) $P(\phi) = 0$ (iii) $P(S) = 1$.

**Remarks:** It follows from above results that,

(i) probability of occurrence of an event is always non-negative;
(ii) probability of occurrence of an impossible event is 0;
(iii) probability of occurrence of a sure event is 1.

**Theorem 2:** If $E$ and $F$ are mutually exclusive events, then,

(i) $P(E \cap F) = 0$ and,
(ii) $P(E \cup F) = P(E) + P(F)$.

***Notes:***

1. For mutually exclusive events $E$ and $F$, we have
$$P(E \text{ or } F) = P(E \cup F) = P(E) + P(F).$$
2. If $E_1, E_2, \ldots, E_k$ are mutually exclusive events, then,
$$P(E_1 \cup E_1 \cup, \cdots, \cup E_k)$$
$$= P(E_1) + P(E_2) + \cdots + P(E_k).$$

**Theorem 3:** If $E$ and $F$ are two mutually exclusive and exhaustive events, then $P(E) + P(F) = 1$.

**Theorem 4:** Let $E$ be any event and $\bar{E}$ be its complementary event, then $P(\bar{E}) = 1 - P(E)$.

**Theorem 5:** For any two events $E$ and $F$,

$$P(E - F) = P(E) - P(E \cap F).$$

**Theorem 6:** **(Addition Theorem).** For any two events $E$ and $F$,

$$P(E \cup F) = P(E) + P(F) - P(E \cap F)$$

***Notes:***

1. We may express the above results as
$$P(E \text{ or } F) = P(E) + (F) - P(E \text{ and } F)$$
2. If $E$ and $F$ are mutually exclusive, then
$$P(E \cap F) = 0 \text{ and so } P(E \cup F) = P(E) + P(F).$$

**Theorem 7:** If $E_1$ and $E_2$ be two events such that $E_1 \subseteq E_2$, then prove that $P(E_1) \leq P(E_2)$.

**Theorem 8:** If $E$ is an event associated with a random experiment, then $0 \leq P(E) \leq 1$.

**Theorem 9:** For any three events $E, F, G$

$$P(E \cup F \cup G) = P(E) + P(F) + P(G) - P(E \cap F)$$
$$- P(F \cap G) - P(E \cap G) + P(E \cap F \cap G)$$

**Illustration 18:** *A* card is drawn at random from a well-shuffled pack of 52 cards. Find the probability of getting

(i) a jack or a queen or a king,

(ii) a two of heart or diamond.

**Solution:**

(i) In a pack of 52 cards, we have:

4 jacks, 4 queens and 4 kings.

Now, clearly a jack and a queen and a king are mutually exclusive events.

$$\text{Also, } P(\text{a jack}) = \frac{^4C_1}{^{52}C_1} = \frac{4}{52} = \frac{1}{13}$$

$$P(\text{a queen}) = \frac{^4C_1}{^{52}C_1} = \frac{4}{52} = \frac{1}{13}$$

$$P(\text{a king}) = \frac{^4C_1}{^{52}C_1} = \frac{4}{52} = \frac{1}{13}.$$

$\therefore$ By the addition theorem of Probability,

$P$(a jack or a queen or a king) = $P$(a jack) + $P$(a queen) + $P$(a king)

$$= \frac{1}{13} + \frac{1}{13} + \frac{1}{13} = \frac{3}{13}.$$

(ii) $P$(two of heart or two of diamond)

= $P$(two of heart) + $P$(two of diamond)

$$= \frac{1}{52} + \frac{1}{52} = \frac{2}{52} = \frac{1}{26}.$$

**Illustration 19:** Find the probability of getting a sum of 7 or 11 in a simultaneous throw of two dice.

**Solution:** When two dice are thrown we have observed that there are 36 possible outcomes. Now, we can have a sum of 7 as

$1 + 6 = 7$, $2 + 5 = 7$, $3 + 4 = 7$, $4 + 3 = 7$, $5 + 2 = 7$, $6 + 1 = 7$

Thus, the six favourable cases are (1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1)

$$\therefore \quad P(\text{a sum of 7}) = \frac{6}{36} = \frac{1}{6}.$$

Again, the favourable cases of getting a sum of 11 are (5, 6), (6, 5)

$$\therefore \quad P(\text{a sum of 11}) = \frac{2}{36} = \frac{1}{18}.$$

Since the events of getting 'a sum of 7' or 'a sum of 11' are mutually exclusive:

$\therefore$ $P$(a sum of 7 or 11)

= $P$(a sum of 7) + $P$(a sum of 11)

$$= \frac{1}{6} + \frac{1}{18} = \frac{4}{18} = \frac{2}{9}.$$

**Illustration 20:** From a well-shuffled pack of 52 cards, a card is drawn at random, find the probability that it is either a heart or a queen.

**Solution:** *A*: Getting a heart card *B*: Getting a queen card

$$P(A) = \frac{13}{52},\ P(B) = \frac{4}{52},\ P(A \cap B) = \frac{1}{52}$$

Required probability

$= P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$$= \frac{13}{52} + \frac{4}{52} - \frac{1}{52} = \frac{16}{52} = \frac{4}{13}.$$

## INDEPENDENT EVENTS

Two event *A* and *B* are said to be independent if the occurrence (or non-occurrence of one does not affect the probability of the occurrence (and hence non-occurrence) of the other.

**Illustration 21:** In the simultaneous throw of 2 coins, 'getting a head' on first coin and 'getting a tail on the second coin are independent events.

**Illustration 22:** When a card is drawn from a pack of well-shuffled cards and replaced before the second card is drawn, the result of second draw is independent of first draw. We now state, without proof, the theorem which gives the probabilities of simultaneous occurrence of the independent events.

**Theorem 10:** If *A* and *B* are two independent events, then

$$P(A \text{ and } B) = P(A).\ P(B)$$

**Illustration 23:** Two dice are thrown. Find dthe probability of getting an odd number on the one die and a multiple of three on the other.

**Solution:** Since the events of 'getting an odd number' on one die and the event of getting a multiple of three on the other are independent events,

$$P(A \text{ and } B) = P(A) \times P(B) \tag{1}$$

Now, $P(A) = P(\text{an odd number}) = \frac{3}{6} = \frac{1}{2}$ [There are 3 odd numbers 1, 3, 5] and $P(B) = P(\text{a multiple of 3}) = \frac{2}{6} = \frac{1}{3}$ [Multiples of 3 are 3 and 6]

$\therefore$ From (1), required probability $= \frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$.

**Illustration 24:** Arun and Tarun appear for an interview for 2 vacancies. The probability of Arun's selection is 1/3 and that of Tarun's selection is 1/5. Find the probability that

(i) only 1 of them will be selected,

(ii) none of them be selected.

**Solution:** Let $A$: Arun is s selected $B$: Tarun is selected.

Then, $P(A) = \frac{1}{3}$ and $P(B) = \frac{1}{5}$.

Clearly, '$A$' and 'not $B$' are independent also 'not $A$' and 'not $B$' are independent, '$B$' and 'not $A$' are independent.

(i) $P$ (only 1 of them will be selected)

$$= P\ (A \text{ and not } B \text{ or } B \text{ and not } A)$$

$$= P\ (A)\ P\ (\text{not } B) + P\ (B)\ P\ (\text{not } A)$$

$$= \frac{1}{3}\left(1-\frac{1}{5}\right)+\frac{1}{5}\left(1-\frac{1}{3}\right)$$

$$= \frac{1}{3}\times\frac{4}{5}\times\frac{1}{5}\times\frac{2}{5} = \frac{4}{15}+\frac{2}{12}$$

$$= \frac{6}{15} = \frac{2}{5}.$$

(ii) $P$ (onle 1 of them be selected)

$$= P\ (\text{not } A \text{ and not } B)$$

$$= P(\text{not } A) \times P(\text{not } B)$$

$$= \left(1-\frac{1}{3}\right)\times\left(1-\frac{1}{5}\right)$$

$$= \frac{2}{3}\times\frac{4}{5} = \frac{8}{15}.$$

## Exercise-I

**1.** In a simultaneous toss of 2 coins, then find the probability of 2 tails.

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$

(c) $\frac{3}{4}$ (d) $\frac{1}{3}$

**2.** In a simultaneous toss of 2 coins, then find the probability of exactly 1 tail.

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$

(c) $\frac{3}{4}$ (d) None of these

**3.** In a simultaneous toss of 2 coins, then find the probability of no tail.

(a) $\frac{3}{4}$ (b) $\frac{1}{2}$

(c) $\frac{1}{4}$ (d) None of these

**4.** 3 coins are tossed. Find the probability of heads.

(a) $\frac{1}{6}$ (b) $\frac{1}{8}$

(c) $\frac{1}{4}$ (d) None of these

**5.** 3 coins are tossed. Find the probability of exactly 2 heads.

(a) $\frac{3}{8}$ (b) $\frac{1}{2}$

(c) $\frac{1}{8}$ (d) None of these

**6.** 3 coins are tossed. Find the probability of at least 2 heads.

(a) $\frac{1}{2}$ (b) $\frac{3}{8}$

(c) $\frac{1}{8}$ (d) None of these

**7.** 3 coins are tossed. Find the probability of atmost 2 heads.

(a) $\frac{3}{8}$ (b) $\frac{1}{2}$

(c) $\frac{7}{8}$ (d) None of these

**8.** 3 coins are tossed. Find the probability of no heads.

(a) $\frac{3}{8}$ (b) $\frac{1}{8}$

(c) $\frac{1}{2}$ (d) None of these

**9.** 3 coins are tossed. Find the probability of at least 1 head and 1 tail.

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$

(c) $\frac{3}{4}$ (d) None of these

**10.** A coin is tossed 3 times. Find the chance that head and tail show alternately.

(a) $\frac{3}{8}$ (b) $\frac{1}{4}$

(c) $\frac{1}{8}$ (d) None of these

**11.** 4 coins are tossed once. Find the probability of 4 tails.

(a) $\frac{1}{16}$ (b) $\frac{5}{16}$

(c) $\frac{9}{16}$ (d) None of these

**12.** 4 coins are tossed once. Find the operability of exactly 3 tails.

(a) $\frac{1}{16}$ (b) $\frac{1}{4}$

(c) $\frac{5}{16}$ (d) None of these

**13.** 4 coins are tossed once. Find the probability of exactly 2 tails.

(a) $\frac{1}{16}$ (b) $\frac{1}{8}$

(c) $\frac{3}{8}$ (d) $\frac{5}{16}$

**14.** 4 coins are tossed once. Find the probability by of at least 1 tail.

(a) $\frac{1}{16}$ (b) $\frac{15}{16}$

(c) $\frac{3}{16}$ (d) None of these

**15.** In a single throw of 2 dice, find the probability of getting a total of 3 or 5.

(a) $\frac{1}{3}$ (b) $\frac{2}{3}$

(c) $\frac{1}{6}$ (d) $\frac{5}{6}$

**16.** In a single throw of 2 dice, find the probability of getting a total of 12.

(a) $\frac{1}{36}$ (b) $\frac{1}{9}$

(c) $\frac{1}{18}$ (d) $\frac{35}{36}$

**17.** In a single throw of 2 dice, find the probability of getting a total of 11.

(a) $\frac{1}{9}$ (b) $\frac{1}{18}$

(c) $\frac{1}{12}$ (d) $\frac{35}{36}$

**18.** In a single throw of 2 dice, find the probability of getting a total of 8.

(a) $\frac{5}{36}$ (b) $\frac{1}{18}$

(c) $\frac{1}{12}$ (d) $\frac{31}{36}$

**19.** In a single throw of 2 dice, the probability of getting a total of 7.

(a) $\frac{5}{36}$ (b) $\frac{1}{18}$

(c) $\frac{1}{6}$ (d) $\frac{5}{6}$

**20.** In a single throw of 2 dice, what is the probability of a doublet?

(a) $\frac{1}{6}$ (b) $\frac{5}{6}$

(c) $\frac{1}{9}$ (d) $\frac{1}{18}$

**21.** In a single throw of 2 dice, what is the probability of a multiple of 2 on 1 and a multiple of 3 on the other?

(a) $\frac{5}{6}$ (b) $\frac{25}{36}$

(c) $\frac{11}{36}$ (d) $\frac{1}{9}$

**22.** 2 dice are thrown. Find the probability of getting an odd number on 1 and a multiple of 3 on the other.

(a) $\frac{5}{6}$ (b) $\frac{25}{36}$

(c) $\frac{11}{36}$ (d) $\frac{1}{9}$

**23.** Doublet of even numbers.

(a) $\frac{1}{36}$ (b) $\frac{1}{18}$

(c) $\frac{1}{12}$ (d) $\frac{1}{9}$

**24.** A sum less than 6.

(a) $\frac{7}{18}$ (b) $\frac{5}{18}$

(c) $\frac{1}{3}$ (d) $\frac{4}{9}$

**25.** A sum more than 7.

(a) $\frac{1}{12}$ (b) $\frac{1}{6}$

(c) $\frac{1}{4}$ (d) $\frac{5}{12}$

**26.** A sum greater than 10.

(a) $\frac{1}{12}$ (b) $\frac{1}{6}$

(c) $\frac{1}{4}$ (d) $\frac{5}{12}$

**27.** A sum at least 10.

(a) $\frac{1}{12}$ (b) $\frac{1}{6}$

(c) $\frac{1}{4}$ (d) $\frac{1}{3}$

**28.** An odd number as the sum.

(a) $\frac{1}{36}$ (b) $\frac{1}{4}$

(c) $\frac{1}{3}$ (d) $\frac{1}{2}$

**29.** An even number as the sum.

(a) $\frac{1}{36}$ (b) $\frac{1}{4}$

(c) $\frac{1}{2}$ (d) $\frac{1}{3}$

**30.** 6 as the product.

(a) $\frac{1}{9}$ (b) $\frac{2}{9}$

(c) $\frac{1}{3}$ (d) $\frac{4}{9}$

**31.** A multiple of 3 as the sum.

(a) $\frac{2}{3}$ (b) $\frac{1}{3}$

(c) $\frac{1}{9}$ (d) $\frac{5}{36}$

**32.** The product a perfect square (square of a natural number).

(a) $\frac{1}{9}$ (b) $\frac{2}{9}$

(c) $\frac{1}{3}$ (d) $\frac{4}{9}$

**33.** At least 1 of the 2 numbers as 4.

(a) $\frac{1}{4}$ (b) $\frac{5}{18}$

(c) $\frac{11}{36}$ (d) $\frac{1}{3}$

**34.** Sum as a prime number

(a) $\frac{5}{12}$ (b) $\frac{1}{2}$

(c) $\frac{7}{12}$ (d) $\frac{3}{4}$

**35.** In a single throw of 3 dice, find the probability of getting a total of 17 or 18.

(a) $\frac{1}{54}$ (b) $\frac{1}{27}$

(c) $\frac{1}{18}$ (d) None of these

**(Q. 36–38):** In a single throw of 3 dice, then find the probability of getting

**36.** A total of 5.

(a) $\frac{1}{4}$ (b) $\frac{1}{18}$

(c) $\frac{1}{36}$ (d) $\frac{1}{9}$

**37.** A total of at most 5.

(a) $\frac{5}{108}$ (b) $\frac{103}{108}$

(c) $\frac{1}{18}$ (d) None of these

**38.** A total of at least 5.

(a) $\frac{7}{54}$ (b) $\frac{1}{54}$

(c) $\frac{53}{54}$ (d) None of these

**39.** What is the chance that a leap year, selected at random will contain 53 Sundays?

(a) $\frac{1}{7}$ (b) $\frac{2}{7}$

(c) $\frac{3}{7}$ (d) $\frac{4}{7}$

**40.** A card is drawn from a pack of 100 cards numbered 1 to 100. Find the probability of drawing a number which is a square.

(a) $\frac{1}{10}$ (b) $\frac{9}{10}$

(c) $\frac{1}{5}$ (d) $\frac{2}{5}$

**41.** The letters of word 'SOCIETY' are placed in a row. What is the probability that three come together?

(a) $\frac{3}{7}$ (b) $\frac{2}{7}$

(c) $\frac{1}{7}$ (d) None of these

**42.** Find the probability that in a random arrangement of letters of the words 'UNIVERSITY' two '$I$'s do not come together.

(a) $\frac{4}{5}$ (b) $\frac{1}{5}$

(c) $\frac{3}{5}$ (d) $\frac{2}{3}$

**43.** If letters of the word PENCIL are arranged in random order, what is the probability that $N$ is always next to $E$?

(a) $\frac{1}{6}$ (b) $\frac{5}{6}$

(c) $\frac{1}{3}$ (d) $\frac{2}{3}$

**44.** 2 dice are thrown. Find the odds in favour of getting the sum 4.

(a) 1:11 (b) 11:1

(c) 4:11 (d) 11:4

**45.** 2 dice are thrown. Find the odds in favour of getting the sum 5.

(a) 8:1 (b) 1:8

(c) 7:8 (d) 8:7

**46.** 2 dice are thrown. Find the odds against getting the sum 6.

(a) 5:31 (b) 6:31

(c) 31:5 (d) 31:6

**47.** What is the probability that 1 card drawn at random from the pack of playing cards may be either a queen or an ace?

(a) $\frac{1}{13}$ (b) $\frac{2}{13}$

(c) $\frac{3}{13}$ (d) None of these

**48.** In a class of 25 students with roll numbers 1 to 25, a student is picked up at random to answer a question. Find the probability that the roll number of the selected student is either multiple of 5 or 7.

(a) $\frac{6}{25}$ (b) $\frac{4}{25}$

(c) $\frac{8}{25}$ (d) $\frac{7}{25}$

**49.** An integer is chosen at random from first two hundred natural numbers. What is the probability that the integer chosen is divisible by 6 or 8?

(a) $\frac{1}{4}$ (b) $\frac{3}{4}$

(c) $\frac{1}{2}$ (d) None of these

**50.** 2 dice are together. What is the probability that the sum of 2 numbers is divisible by 3 or by 4?

(a) $\frac{4}{9}$ (b) $\frac{2}{9}$

(c) $\frac{5}{9}$ (d) $\frac{1}{3}$

**51.** In a simultaneous throw of 2 dice, find $P(A \text{ or } B)$ if $A$ denotes the event '$a$ total of 11 and $B$ denotes the event' 'an odd number on each die'.

(a) $\frac{11}{36}$ (b) $\frac{1}{4}$

(c) $\frac{5}{18}$ (d) $\frac{1}{6}$

**52.** A box contains 36 tickets numbered 1 to 36, 1 ticket drawn at random. Find the probability that the number on the ticket is either divisible by 3 or is a perfect square.

(a) $\frac{2}{9}$ (b) $\frac{4}{9}$

(c) $\frac{5}{9}$ (d) $\frac{1}{3}$

**53.** A drawer contain 50 bolts and 150 nuts. Half of the bolts and half of the nuts are rusted. If 1 item is chosen at random, then what is the probability that it is rusted or is a bolt?

(a) $\frac{3}{8}$ (b) $\frac{1}{2}$

(c) $\frac{5}{8}$ (d) None of these

**54.** 2 unbiased dice are thrown. Find the probability that neither a doublet nor a total of 10 will appear.

(a) $\frac{7}{9}$ (b) $\frac{4}{9}$

(c) $\frac{2}{9}$ (d) $\frac{1}{3}$

**55.** 2 dice are thrown together. What is the probability that the sum of the number on 2 faces is neither 9 nor 11?

(a) $\frac{1}{6}$ (b) $\frac{5}{6}$

(c) $\frac{2}{3}$ (d) $\frac{1}{2}$

**56.** A card is drawn from a pack of 52 cards, find the probability of getting spade or ace or red card.

(a) $\frac{9}{13}$ (b) $\frac{4}{13}$

(c) $\frac{11}{13}$ (d) $\frac{10}{13}$

**57.** A ticket is drawn from two hundred tickets numbered from 1 to 200, find the probability that the number is divisible by 2 or 3 or 5.

(a) $\frac{73}{100}$ (b) $\frac{27}{100}$

(c) $\frac{63}{100}$ (d) None of these

**58.** $A$ and $B$ are mutually exclusive events of an experiment. If $P$('not $A$') = 0.65, $P(A \cup B) = 0.65$ and $P(B) = p$, find the value of $p$.

(a) 0.70 (b) 0.30

(c) 0.63 (d) 0.35

**59.** The probability of an event $A$ occurring is 0.5 and that of $B$ is 0.3. If $A$ and $B$ are mutually exclusive events, find the probability that neither $A$ nor $B$ occurs.

(a) 0.2 (b) 0.8

(c) 0.6 (d) None of these

**60.** The probabilities that a student will receive an $A$, $B$, $C$ or $D$ grade are 0.30, 0.38, 0.22 and 0.01, respectively. What is the probability that the student will receive at least $B$ grade?

(a) 0.38 (b) 0.42

(c) 0.68 (d) None of these

**61.** The probability that a contractor will get a plumbing contract is 2/3 and the probability that he will not get an electric contract is 5/9. If the probability of getting at least 1 contract is 4/5, what is the probability that he will get both?

(a) $\frac{8}{45}$ (b) $\frac{31}{45}$

(c) $\frac{14}{45}$ (d) None of these

**62.** A card is drawn from an ordinary pack and a gambler bets that it is a spade or an ace. What are the odds against his winning the bet?

(a) 9:4 (b) 4:9

(c) 5:9 (d) 9:5

**63.** In a race the odds in favour of horses $A$, $B$, $C$ and $D$ are 1:3, 1:4, 1:5 and 1:6, respectively. Find the probability that one of them wins the race.

(a) $\frac{221}{420}$ (b) $\frac{391}{420}$

(c) $\frac{331}{420}$ (d) None of these

**64.** A Chartered Accountant applies for a job in 2 firms $X$ and $Y$. The ability of his being selected in firm $X$ is 0.7, and being rejected at $Y$ is 0.5 and the probability of at least 1 of his applications being rejected is 0.6. What is the probability that he will be selected in 1 of the firms?

(a) 0.2 (b) 0.8

(c) 0.4 (d) 0.7

**65.** There are three events $A$, $B$, $C$ one of which must and only one can happen, the odds are 8 to 3 against $A$, 5 to 2 against $B$, find the odds against $C$.

(a) 43:34 (b) 34:43

(c) 43:77 (d) 77:43

**66.** A problem in Statistics is given to four students $A$, $B$, $C$ and $D$. Their chances of solving it are $\frac{1}{3}, \frac{1}{4}, \frac{1}{5}$ and $\frac{1}{6}$, respectively. What is the probability that the problem will be solved?

(a) $\frac{1}{3}$ (b) $\frac{2}{3}$

(c) $\frac{4}{5}$ (d) None of these

**(Q. 67–69):** 1 bag contains 4 white and 2 black balls. Another contains 3 white and 5 black balls. 1 ball is drawn from each bag.

**67.** Find the probability that both are white.

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$

(c) $\frac{1}{4}$ (d) $\frac{3}{4}$

**68.** Find the probability that both are black.

(a) $\frac{5}{24}$ (b) $\frac{19}{24}$

(c) $\frac{11}{24}$ (d) $\frac{1}{24}$

**69.** Find the probability that 1 is white and 1 is black.

(a) $\frac{11}{24}$ (b) $\frac{13}{24}$

(c) $\frac{1}{2}$ (d) None of these

**(Q. 70–77):** An urn contains 25 balls numbered 1 to 25. Suppose an odd number is considered a 'success'. 2 balls are drawn from the urn with replacement.

**70.** Find the probability of getting two successes.

(a) $\frac{169}{625}$ (b) $\frac{312}{625}$

(c) $\frac{481}{625}$ (d) $\frac{144}{625}$

**71.** Find the probability of getting exactly one success.

(a) $\frac{169}{625}$ (b) $\frac{312}{625}$

(c) $\frac{481}{625}$ (d) $\frac{144}{625}$

**72.** Find the probability of getting at least one success.

(a) $\frac{169}{625}$ (b) $\frac{312}{625}$

(c) $\frac{481}{625}$ (d) $\frac{144}{625}$

**73.** Find the probability of getting no success.

(a) $\frac{169}{625}$ (b) $\frac{312}{625}$

(c) $\frac{481}{625}$ (d) $\frac{144}{625}$

**74.** Find the probability of getting 3 successes.

(a) $\frac{1}{27}$ (b) $\frac{2}{9}$

(c) $\frac{26}{27}$ (d) $\frac{7}{27}$

**75.** Find the probability of getting exactly 2 succeses.

(a) $\frac{1}{27}$ (b) $\frac{2}{9}$

(c) $\frac{26}{27}$ (d) $\frac{7}{27}$

**76.** Find the probability of getting at most 2 successes.

(a) $\frac{1}{27}$ (b) $\frac{2}{9}$

(c) $\frac{26}{27}$ (d) $\frac{7}{27}$

**77.** Find the probability of getting at least 2 successes.

(a) $\frac{1}{27}$ (b) $\frac{2}{9}$

(c) $\frac{26}{27}$ (d) $\frac{7}{27}$

**78.** From a pack of cards, two are drawn, the first being replaced before the second is drawn. Find the probability that the first is a diamond and the second is a king.

(a) $\frac{3}{52}$ (b) $\frac{1}{26}$

(c) $\frac{1}{52}$ (d) $\frac{1}{4}$

**(Q. 79–82):** A husband and wife appear in an interview for 2 vacancies in the same post. The probability of husband's selection is 1/7 and that of wife's is 1/7.

**79.** What is the probability that only 1 of them will be selected?

(a) $\frac{2}{7}$ (b) $\frac{1}{35}$

(c) $\frac{24}{35}$ (d) $\frac{11}{35}$

**80.** What is the probability that both of them will be selected?

(a) $\frac{2}{7}$ (b) $\frac{1}{35}$

(c) $\frac{24}{35}$ (d) $\frac{11}{35}$

**81.** What is the probability that none of them will be selected?

(a) $\frac{2}{7}$ (b) $\frac{1}{35}$

(c) $\frac{24}{35}$ (d) $\frac{11}{35}$

**82.** What is the probability that at least one of them will be selected?

(a) $\frac{2}{7}$ (b) $\frac{1}{35}$

(c) $\frac{24}{35}$ (d) $\frac{11}{35}$

**(Q. 83–86):** Probability that a man will be alive 25 years hence is 0.3 and the probability that his wife will be alive after 25 years hence is 0.4. Find the probability that 25 years hence.

**83.** Both will be alive.

(a) 0.12 (b) 0.18
(c) 0.28 (d) 0.58

**84.** Only the man will be alive.

(a) 0.12 (b) 0.18
(c) 0.28 (c) 0.58

**85.** Only the woman will be alive.

(a) 0.12 (b) 0.18
(c) 0.28 (d) 0.58

**86.** At least 1 of them will be alive.

(a) 0.12 (b) 0.18
(c) 0.28 (d) 0.58

**87.** A man speaks truth in 80% of the cases and another in 90% of the cases. While stating the same fact, what is the probability that they contradict?

(a) $\frac{37}{50}$ (b) $\frac{13}{50}$

(c) $\frac{16}{50}$ (d) None of these

**88.** There are 3 urns $A$, $B$ and $C$, $A$ contains 4 red balls and 3 black balls. Urn $B$ contains 5 red balls and 4 black balls. Urn $C$ contains 4 red balls and 4 black balls. One ball is drawn from each of these urns. What is the probability that the 3 balls drawn consist of 2 red balls and a black ball?

(a) $\frac{47}{42}$ (b) $\frac{25}{42}$

(c) $\frac{19}{42}$ (d) $\frac{23}{42}$

**89.** An anti-aircraft gun can take a maximum of 4 shots at an enemy plane moving away from it. The probability of hitting the plane at the first, second third and fourth shots are 0.4, 0.3, 0.2 and 0.1, respectively. What is the probability that the gun hits the plane?

(a) 0.4379 (b) 0.6872
(c) 0.6976 (d) None of these

**90.** $A$ can solve 90% of the problems given in a book and $B$ solve 70%. What is the probability that at least 1 of them will solve a problem selected at random from the book?

(a) $\frac{3}{100}$ (b) $\frac{97}{100}$

(c) $\frac{83}{100}$ (d) $\frac{17}{100}$

**91.** $A$ and $B$ throw a coin alternately till 1 of them gets a head and wins the game. If $A$ starts the game, find the probability of winning of $A$.

(a) $\frac{1}{3}$ (b) $\frac{2}{3}$

(c) 1 (d) None of these

**92.** 2 persons $A$ and $B$ throw a die alternately till 1 of them gets a '6' and wins the game. Find the probability of winning of $B$.

(a) $\frac{5}{11}$ (b) $\frac{6}{11}$

(c) $\frac{4}{11}$ (d) $\frac{3}{11}$

**93.** The letters of the word 'SOCIETY' are placed at row. What is probability that the 3 vowels come together?

(a) $\frac{4}{7}$ (b) $\frac{3}{7}$

(c) $\frac{2}{7}$ (d) $\frac{1}{7}$

**94.** Find the probability that in a random arrangement of the letters of the word DAUGHTER, the letter D occupies the first place.

(a) $\frac{1}{8}$ (b) $\frac{1}{4}$

(c) $\frac{3}{8}$ (d) $\frac{1}{2}$

## Exercise-2
## (Based on Memory)

**Directions (Q. 1–2):** Study the information carefully to answer the questions that follow:

A basket contains 3 blue, 2 green and 5 red balls.

**1.** If 3 balls are picked at random, what is the probalility that at least on is red?

(a) $\frac{1}{2}$ (b) $\frac{7}{12}$

(c) $\frac{11}{12}$ (d) $\frac{1}{5}$

(e) None of these

**[Bank of Maharashtra PO, 2007]**

**2.** If 4 balls are picked at random, what is the probability that 2 are green and 2 are blue?

(a) $\frac{1}{18}$ (b) $\frac{1}{70}$

(c) $\frac{3}{5}$ (d) $\frac{1}{2}$

(e) None of these

**[Bank of Maharashtra PO, 2007]**

**3.** Out of 15 students studying in a class, 7 are from Maharashtra, 5 are from Karnataka and 3 are from Goa. 4 students are to be selected at random. What are the chances that at least 1 is from Karnataka?

(a) $\frac{12}{13}$ (b) $\frac{11}{13}$

(c) $\frac{10}{15}$ (d) $\frac{1}{15}$

(e) None of these

**[Guwahati PO, 1999]**

4. The probability that a teacher will give one surprise test during any class meeting in a week is $\frac{1}{5}$. If a student is absent twice, what is the probability that he will miss at least one test?

(a) $\frac{4}{15}$ (b) $\frac{1}{15}$

(c) $\frac{91}{25}$ (d) $\frac{16}{125}$

(e) None of these

**[BSRB Mumbai PO, 1999]**

**5.** A speaks truth in 75% and *B* in 80% cases. In what percentage of case are they likely to contradict each other when narrating the same incident?

(a) 35 (b) 30

(c) 25 (d) 20

(e) None of these

**[BSRB Chennai PO, 2000]**

**6.** In a box there are 8 red, 7 blue and 6 green balls. One ball is picked up randomly. What is the probability that it is neither red nor green?

(a) $\frac{7}{19}$ (b) $\frac{2}{3}$

(c) $\frac{3}{4}$ (d) $\frac{9}{21}$

(e) None of these

**[IBPS Bank PO Examination, 2002]**

**7.** An urn contains 3 red and 4 green marbles. If 3 marbles are picked at random, then what is the probability that 2 are green and 1 is red?

(a) $\frac{3}{7}$ (b) $\frac{18}{35}$

(c) $\frac{5}{14}$ (d) $\frac{4}{21}$

(e) None of these

**[New Indian Insurance PO, 2009]**

**8.** A basket contains 3 blue and 4 red balls. If 3 balls are drawn at random from the basket, then what is the probability that all the 3 are either blue or red ?

(a) 1 (b) $\frac{1}{7}$

(c) $\frac{3}{14}$ (d) None of these

**[Bank of India PO, 2010]**

**9.** A bag contains 13 white and 7 black balls. 2 balls are drawn at random. What is the probability that they are of the same colour?

(a) $\frac{41}{190}$ (b) $\frac{21}{190}$

(c) $\frac{59}{190}$ (d) $\frac{99}{190}$

(e) $\frac{77}{190}$

**[IBPS PO/MT, 2012])**

**Direction (Q. 10–14):** Study the given information carefully to answer the question that follow.
An urn contains 4 green, 5 blue, 2 red and 3 yellow marbles.

**10.** If 2 marbles are drawn at random, what is the probability that both are red or at least 1 is red?

(a) $\frac{26}{91}$ (b) $\frac{1}{7}$

(c) $\frac{199}{364}$ (d) $\frac{133}{191}$

(e) None of these

**[IBPS PO/MT, 2011]**

**11.** If 3 marbles are drawn at random, what is the probability that at least 1 is yellow?

(a) $\frac{1}{3}$ (b) $\frac{199}{364}$

(c) $\frac{165}{364}$ (d) $\frac{3}{11}$

(e) None of these

**[IBPS PO/MT, 2011]**

**12.** If 8 marbles are drawn at random, what is the probability that there are equal numbers of marbles of each colour?

(a) $\frac{4}{7}$ (b) $\frac{361}{728}$

(c) $\frac{60}{1001}$ (d) $\frac{1}{1}$

(e) None of these

**[IBPS PO/MT, 2011]**

**13.** If 3 marbles are drawn at random, what is the probability that none is green?

(a) $\frac{2}{7}$ (b) $\frac{253}{728}$

(c) $\frac{10}{21}$ (d) $\frac{14}{91}$

(e) $\frac{30}{91}$

**[IBPS PO/MT, 2011])**

**14.** If 4 marbles are drawn at random, what is the probability that 2 are blue and 2 are red?

(a) $\frac{10}{1001}$ (b) $\frac{9}{14}$

(c) $\frac{17}{364}$ (d) $\frac{2}{7}$

(e) None of these

**[IBPS PO/MT, 2011]**

**15.** Out of 5 girls and 3 boys, 4 children are to be randomly selected for a quiz contest. What is the probability that all the selected children are girls?

(a) $\frac{1}{14}$ (b) $\frac{1}{7}$

(c) $\frac{5}{17}$ (d) $\frac{2}{17}$

(e) None of these

**[SBI Associates Banks PO, 2011]**

**Directions (Q. 16–18):** Study the given information carefully and answer the questions that follow:
A basket contains 4 red, 5 blue and 3 green marbles.

**16.** If 3 marbles are picked at random, what is the probability that either all are green or all are red?

(a) $\frac{7}{44}$ (b) $\frac{7}{12}$

(c) $\frac{5}{12}$ (d) $\frac{1}{44}$

(e) None of these

**[SBI Associate Banks PO, 2010]**

**17.** If 2 marbles are drawn at random, what is the probability that both are red?

(a) $\frac{3}{7}$ (b) $\frac{1}{2}$

(c) $\frac{2}{11}$ (d) $\frac{1}{6}$

(e) None of these

**[SBI Associate Banks PO, 2010]**

**18.** If 3 marbles are picked at random, what is the probability that at least 1 is blue?

(a) $\frac{7}{12}$ (b) $\frac{37}{44}$

(c) $\frac{5}{12}$ (d) $\frac{7}{44}$

(e) None of these

**[SBI Associate Banks PO, 2010]**

**Directions (Q. 19–23):** Study the following information carefully to answer the questions that follow:
A box contains 2 blue caps, 4 red caps, 5 green caps and 1 yellow cap.

**19.** If 4 caps are picked at random, what is the probability that none is green?

(a) $\frac{7}{99}$ (b) $\frac{5}{99}$

(c) $\frac{7}{12}$ (d) $\frac{5}{12}$

(e) None of these

**[OBC PO, 2009]**

**20.** If 2 caps are picked at random, what is the probability that both are blue?

(a) $\frac{1}{6}$ (b) $\frac{1}{10}$

(c) $\frac{1}{12}$ (d) $\frac{1}{45}$

(e) None of these

**[OBC PO, 2009]**

**21.** If 1 cap is picked at random, what is the probability that it is either blue of yellow?

(a) $\frac{2}{9}$ (b) $\frac{1}{4}$

(c) $\frac{3}{8}$ (d) $\frac{6}{11}$

(e) None of these

**[OBC PO, 2009]**

**22.** If 2 caps are picked at random, what is the probability that at least 1 is red?

(a) $\frac{1}{3}$ (b) $\frac{16}{21}$

(c) $\frac{19}{33}$ (d) $\frac{7}{19}$

(e) None of these

**[OBC PO, 2009]**

**23.** If 3 caps are picked at random, what is the probability that 2 are red and 1 is green?

(a) $\frac{9}{22}$ (b) $\frac{6}{19}$

(c) $\frac{1}{6}$ (d) $\frac{3}{22}$

(e) None of these

**[OBC PO, 2009]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (a) | **3.** (c) | **4.** (b) | **5.** (a) | **6.** (a) | **7.** (c) | **8.** (b) | **9.** (c) | **10.** (b) | **11.** (a) | **12.** (b) | **13.** (c) |
| **14.** (b) | **15.** (c) | **16.** (a) | **17.** (b) | **18.** (a) | **19.** (c) | **20.** (a) | **21.** (c) | **22.** (c) | **23.** (c) | **24.** (b) | **25.** (d) | **26.** (a) |
| **27.** (b) | **28.** (d) | **29.** (c) | **30.** (a) | **31.** (b) | **32.** (b) | **33.** (c) | **34.** (a) | **35.** (a) | **36.** (c) | **37.** (a) | **38.** (c) | **39.** (b) |
| **40.** (a) | **41.** (c) | **42.** (a) | **43.** (a) | **44.** (a) | **45.** (b) | **46.** (c) | **47.** (b) | **48.** (c) | **49.** (a) | **50.** (c) | **51.** (a) | **52.** (b) |
| **53.** (c) | **54.** (a) | **55.** (b) | **56.** (d) | **57.** (a) | **58.** (b) | **59.** (a) | **60.** (c) | **61.** (c) | **62.** (a) | **63.** (b) | **64.** (b) | **65.** (a) |
| **66.** (b) | **67.** (c) | **68.** (a) | **69.** (c) | **70.** (a) | **71.** (b) | **72.** (c) | **73.** (d) | **74.** (a) | **75.** (b) | **76.** (c) | **77.** (d) | **78.** (c) |
| **79.** (a) | **80.** (b) | **81.** (c) | **82.** (d) | **83.** (a) | **84.** (b) | **85.** (c) | **86.** (d) | **87.** (b) | **88.** (a) | **89.** (c) | **90.** (b) | **91.** (b) |
| **92.** (a) | **93.** (d) | **94.** (a) | | | | | | | | | | |

### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (b) | **3.** (b) | **4.** (b) | **5.** (a) | **6.** (e) | **7.** (b) | **8.** (d) | **9.** (d) | **10.** (e) | **11** (b) | **12.** (c) | **13.** (e) |
| **14.** (a) | **15.** (a) | **16.** (d) | **17.** (e) | **18.** (b) | **19.** (a) | **20.** (e) | **21.** (b) | **22.** (c) | **23.** (d) | | | |

# EXPLANATORY ANSWERS

## EXERCISE-1

**1.** **(b)** Sample space $S$ = {HH, HT, TH, TT}
Number of exhaustive cases = 4
There is only one favourable case TT.
$\therefore \quad P(2 \text{ tails}) = \frac{1}{4}$.

**2.** **(a)** Sample space $S$ = {HH, HT, TH, TT}
Number of exhaustive cases = 4
There are two favourable cases HT, TH.
$\therefore \quad P(\text{exactly 1 tail}) = \frac{2}{4} = \frac{1}{2}$.

**3.** **(c)** Sample space $S$ = {HH, HT, TH, TT}
Number of exhaustive cases = 4.
There is only one favourable case HH.
$\therefore \quad P(\text{no tails}) = \frac{1}{4}$.

**4.** **(b)** Sample space $S$ = {HHH, HHT, HTH, HTT, THT, TTH, THH, TTT}
Number of exhaustive cases = 8
There is only one favourable case HHH.
$\therefore \quad P(\text{all heads}) = \frac{1}{8}$.

**5.** **(a)** Sample space $S$ = {HHH, HHT, HTH, HTT, THT, TTH, THH, TTT}
Number of exhaustive cases = 8.
There are three favourable cases HHT, HTH, THH.
$\therefore \quad P(\text{exactly 2 heads}) = \frac{3}{8}$.

**6.** **(a)** Sample space $S$ = {HHH, HHT, HTH, HTT, TTH, THH, TTT}
Number of exhaustive cases = 8
There are four favourable cases HHT, HTH, THH, HHH.
$\therefore \quad P(\text{at least 2 heads}) = \frac{4}{8} = \frac{1}{2}$.

**7.** (c) Sample space $S$ = {HHH, HHT, HTH, HTT, TTH, THH, TTT}
Number of exhaustive cases = 8.
$P$(atmost 2 heads) = $P$(not 3 heads)
$= 1 - P(3 \text{ heads}) = 1 - \frac{1}{8} = \frac{7}{8}$.

**8.** **(b)** Sample space $S$ = {HHH, HHT, HTH, HTT, THT, TTH, THH, TTT}
Number of exhaustive cases = 8
$P(\text{no heads}) = P(\text{all tails}) = \frac{1}{8}$.
($\because$ there is only favourable case ttt).

**9.** **(c)** There are 6 favourable cases HHT, HTH, HTT, THT, TTH, THH.
Required probability = $\frac{6}{8} = \frac{3}{4}$.

**10.** **(b)** Sample space $S$ = {HHH, HHT, HTT, HTT, THH, THT, TTH, TTT}
Number of exhaustive cases = 8.
Favourable cases are HTH, THT
Number of favourable cases = 2.
$\therefore$ Required probability = $\frac{2}{8} = \frac{1}{4}$.

**11.** **(a)** There are $2^4 = 16$ possible outcomes.
Sample space S = {HHHH, HHHT, HHTH, HTHH,THHH, HHTT, HTHT, HTTH, THTH, TTHH, TTHH, TTTH, TTHT, THTT, HTTT, TTTT}
There is only one favourable case TTTT.
$P(4 \text{ tails}) = \frac{1}{16}$.

**12.** **(b)** There are 4 favourable cases TTTH, TTHT, THTT, HTTT,
$\therefore \quad P(\text{exactly 3 tails}) = \frac{4}{16} = \frac{1}{4}$.

**13.** **(c)** There are 6 favourable cases HHTT, HTHT, HTTH, THHT, THTH, TTHH.
$\therefore \quad P(\text{exactly 2 tails}) = \frac{6}{16} = \frac{3}{8}$

**14.** **(b)** $P$ (at least 1 tail) = $P$(not all heads)
$= 1 - P(\text{all heads})$
$= 1 - \frac{1}{16} = \frac{15}{16}$.

**15.** **(c)** A total of 3 or 5 may be obtained in 6 ways, viz, (1, 2), (2, 1), (1, 4), (2, 3), (3, 2), (4, 1).
Number of exhaustive cases = $6 \times 6 = 36$.
$\therefore$ Probability of getting a total of 3 or 5 = $\frac{6}{36} = \frac{1}{6}$.

**16.** **(a)** A total of 12 may be obtained in 1 way, viz, (6, 6).
$\therefore$ Required probability = $\frac{1}{36}$.

**17.** **(b)** A total of 11 may be obtained in 2 ways, viz, (5, 6), (6, 5).
$\therefore$ Required probability = $\frac{2}{36} = \frac{1}{18}$.

**18.** **(a)** A total of 8 may be obtained in 5 ways, viz, (2, 6), (3, 5), (4, 4), (5, 3), 6, 2).
$\therefore$ Required probability = $\frac{5}{36}$.

**19.** **(c)** A total of 7 may be obtained in 6 ways, viz, (1, 6), (2, 5), (3, 4), (5, 2), (6, 1).

$\therefore$ Required probability = $\dfrac{6}{36} = \dfrac{1}{6}$.

**20.** **(a)** A 'doublet' means that both the dice show the same number on the upper most faces. Therefore, the outcomes, favourable to this event are

(1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6)

Thus, the number of favourable cases = 6.

Hence, $P(\text{doublet}) = \dfrac{6}{36} = \dfrac{1}{6}$.

**21.** **(c)** In this case, the favourable cases are

(2, 3), (2, 6), (4, 3), (4, 6), (6, 3), (6, 6), (3, 2), (3, 4), (3, 6), (6, 2), (6, 4).

Thus, the number of favourable cases = 11.

$\therefore$ Required probability = $\dfrac{11}{36}$.

**22.** **(c)** Favourable cases are

(1, 3), (1, 6), (3, 3), (3, 6), (5, 3), (5, 6), (3, 1), (6, 1), (6, 3), (3, 5), (6, 6)

Total Number of exhaustive cases = 6 × 6 = 36

$\therefore$ Required probability = $\dfrac{11}{36}$.

**23.** **(c)** *A:* Getting doublet of even number $A$ =[(2, 2), (4, 4), (6, 6)]

$$n(A) = 3 \ n(S) = 36$$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{3}{36} = \dfrac{1}{12}$.

**24.** **(b)** $A$: Getting total less than 6

$A$ = [(1, 1), (1, 2), (2, 1), (2, 2), (3, 1), (1, 3), (4, 1), (1,4), (3, 2), (2, 3)]

$$n(A) = 10,\ n(A),\ n\ (S) = 36$$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{10}{36} = \dfrac{5}{18}$.

**25.** **(d)** $A$: Getting total more than 7

[(5, 3), (3, 5), (6, 2), (2, 6), (4, 4), (6, 3), (3, 6), (5, 4), (4, 5),

(6, 4), (4, 6), (5, 5), (6, 5), (5, 6), (6, 6)]

$$n\ (A) = 15,\ n(S) = 36$$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{15}{36} = \dfrac{5}{12}$.

**26.** **(a)** $A$: Sum greater than 10.

$A$ = [(6, 5), (5, 6), (6, 6)] $n(A) = 3$, $n(S) = 36$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{3}{36} = \dfrac{1}{12}$.

**27.** **(b)** $A$: a sum of at least 10 (i.e., 10 or more than 10)

$A$ = [(6, 4), (4, 6), (5, 5), (6, 5), (5, 6), (6, 6)]

$$n(A) = 6,\ n(S) = 36$$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{6}{36} = \dfrac{1}{6}$.

**28.** **(d)** $A$: Getting sum as an odd number

$A$ = [(1, 2), (2, 1), (1, 4), (4, 1), (2, 3), (3, 2), (4, 3), (3, 4), (6, 1), (1, 6), (5, 2), (2, 5), (5, 4) (4, 5), (6, 3), (6, 5), (5, 6)]

$$n(A) = 18,\ n(S) = 36$$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{18}{36} = \dfrac{1}{2}$.

**29.** **(c)** $A$: Getting even number as the sum

$A$ = [(1, 1), (1, 3), (3, 1), (2, 2), (3, 3), (4, 2), (2, 4), (5,1), (1, 5), (6, 2), (2, 6), (5, 3), (3, 5), (4, 4), (5, 5), (6, 4), (4, 6), (6, 6)]

$$n(A) = 18,\ n(S) = 36$$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{18}{36} = \dfrac{1}{2}$.

**30.** **(a)** $A$: Getting 6 as the product

$A$ = [(1, 6), (6, 1), (2, 3), (3, 2)]

$$n(A) = 4,\ n(S) = 36$$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{4}{36} = \dfrac{1}{9}$.

**31.** **(b)** *A:* Getting a multiple of 3 as the sum

$A$ = [(1, 2), (2, 1), (3, 3), (5, 1), (1, 5), (4, 2), (2, 4), (6,3), (3, 6), (4, 5), (5, 4), (6, 6)]

$$n(A) = 12,\ n(S) = 36$$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{12}{36} = \dfrac{1}{3}$.

**32.** **(b)** *A:* Getting the product of two numbers to be a perfect square

$A$ = [(1, 1), (1, 4), (2, 2), (4, 1), (3, 3), (4, 4), (5, 5), (6, 6)]

$$n(A) = 8,\ n(S) = 36$$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{8}{36} = \dfrac{2}{9}$.

**33.** **(c)** $A$: Getting at least one of the two number as 4.

$A$ = [(1, 4), (2, 4), (3, 4), (4, 4), (5, 4), (6, 4), (4, 1), (4 ,2), (4, 3), (4, 5), (4, 6)]

$n(A) = 11$, $n(S) = 36$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{11}{36}$.

**34.** **(a)** $A$: Getting sum as a prime number

$A$ = [(1, 1), (1, 2), (2, 1), (2, 3), (3, 2), (4, 1), (1, 4), (4, 3), (3, 4), (6, 1), (1, 6), (2, 5), (5, 2), (6, 5), (5, 6)]

$$n(A) = 11,\ n(S) = 36$$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{15}{36} = \dfrac{5}{12}$.

**35. (a)** Number of exhaustive cases in a single throw of three dice

$= 6 \times 6 \times 6 = 216$

Cases favourable to a total of 17 are (5, 6, 6), (6, 5, 6), (6, 6, 5)

Number of cases favourable to a total of 17 or 18 is 4.

$\therefore$ $P$(a total of 17 or 18) $= \frac{4}{216} = \frac{1}{54}$.

**36. (c)** Number of exhaustive cases in a single throw of three dice $= 6 \times 6 \times 6 = 216$.

Cases favourable to a total of 5 are (1, 2, 2), (2, 1, 2), (2, 2, 1), (1, 1, 3), (1, 3, 1), (3, 1, 1).

$\therefore$ $P$(a total of 5) $= \frac{6}{216} = \frac{1}{36}$.

**37. (a)** A total of at most 5 means a total 3, 4 or 5.

Cases favourable to a total of 3 are (1, 1, 1)

Cases favourable to a total of 4 are (1, 1, 2), (1, 2, 1), (2, 1, 1)

Cases favourable to a total of 5 are (1, 2, 2), (2, 1, 2), (2, 2, 1),

(1, 1, 3), (1, 3, 1), (3, 1, 11).

Number of cases favourable to a total of 3 or 4 or 5 is 10.

$\therefore$ $P$(a total of at most 5) $= \frac{10}{216} = \frac{5}{108}$.

**38. (c)** A total of at least 5 means not a total of 3 or 4.

Number of cases favourable to a total of 3 or 4 is 4.

$P$(a total of 3 or 4) $= \frac{4}{216} = \frac{1}{54}$

$\therefore$ $P$(a total of at least 5) $= P$(not a total of 3 or 4)

$= 1 - P$(a total of 3 or 4)

$= 1 - \frac{1}{54} = \frac{53}{54}$.

**39. (b)** We know that a leap year has 366 days and thus a leap year has 52 weeks and 2 days over.

The two over (successive days have the following likely cases:

(i) Sunday and Monday

(ii) Monday and Tuesday

(iii) Tuesday and Wednesday

(iv) Wednesday and Thursday

(v) Thursday and Friday

(vi) Firday and Saturday

(vii) Saturday and Sunday.

$\therefore$ Number of exhaustive cases '$n$' = 7.

Out of these, the favourable cases are (i) and (vii)

$\therefore$ Number of favourable cases '$m$' = 2

$\therefore$ Probability of having 53 Sundays $= \frac{2}{7}$.

**40. (a)** $A$: Getting a number which is a square

$A = (1, 4, 9, 16, 25, 36, 49, 64, 81, 100)$

$n(A) = 10$, $n(S) = 100$

$\therefore$ Required probability $= P(A) = \frac{n(A)}{n(S)} = \frac{10}{100} = \frac{1}{10}$.

**41. (c)** There are 7 letters in the word 'SOCIETY' which can be arranged in 71 ways. Considering the three vowels in the word 'SOCIETY' as one letter, we can arrange 5 letters in a row in 5! ways. Also, three vowels can themselves be arranged in 3! ways.

$\therefore$ The total number of arrangements in which three vowels come together are $5! \times 3!$

Hence, the required probability $= \frac{5!\times 3!}{7!} = \frac{3\times 2\times 1}{7\times 6} = \frac{1}{7}$.

**42. (a)** Out of the letters in the word 'UNIVERSITY' two letters '$I$' are alike.

$\therefore$ Number of permutations $= \frac{10!}{2}$ (i)

Number of words in which two '$I$' are never together

= Total number of words – Number of words in which two '$I$' are together

$= \frac{10!}{2} - 9! = \frac{10! - 2\cdot 9!}{2} = \frac{9![10-2]}{2} = \frac{9!.8}{2} = 9!\cdot 4$

$\therefore$ Required probability $= \frac{9\cdot 4}{10!/2} = \frac{9!\cdot 8}{10!} = \frac{8}{10} = \frac{4}{5}$.

**43. (a)** Number of ways in which 6 letters of the word PENCIL can be arranged is $P(6, 6) = 6!$.

If $N$ is next to $E$, they can be considered as one and the 5 letters can be arranged in $P(5, 5) = 5!$ ways.

$\therefore$ The required probability $= \frac{5!}{6!} = \frac{1}{6}$.

**44. (a)** Let, $A$ be the event of "getting the sum 4".

Then, $A = [(1, 32), (3, 1), (2, 2)]$.

Therefore, 3 favourable outcomes and $(36 - 3) = 33$ outcomes are unfavourable.

$\therefore$ Odds in favour of sum of 4 $= \frac{3}{33} = \frac{1}{11}$.

**45. (b)** Let, $A$ be the event of "getting a sum of 5".

Then, $A = [(1, 4), (4, 1), (2, 3), (3, 2)]$.

There are 4 favourable outcomes and $(36 - 4) = 32$ outcomes are unfavourable.

$\therefore$ Odds in favour of sum 5 $= \frac{4}{32} = \frac{1}{8}$.

**46. (c)** Let $A$ be the event "getting the sum 6".

Then, $A = [(1, 5), (5, 1), (2, 4), (4, 2), (3, 3)]$

There are 5 favourable outcomes and $(36 - 5) = 31$ outcomes are unfavourable.

$\therefore$ Odds against getting the sum 6 $= \frac{31}{5}$.

**47.** **(b)** $A$: Getting a queen $B$: Getting an ace

$P(A) = \dfrac{4}{52}$, $P(B) = \dfrac{4}{52}$, $P(A \cap B) = \dfrac{0}{52} = 0$

$\therefore$ Required probability $= P(A \cup B)$

$= P(A) + P(B) - P(A \cap B)$

$= \dfrac{4}{52} + \dfrac{4}{52} - 0 = \dfrac{8}{52} = \dfrac{2}{13}$.

**48.** **(c)** $A$: Roll number is multiple of 5 $B$: Roll number is\ multiple of 7

$A = (5, 10, 15, 20, 25)$ $B = (7, 14, 21)$

$P(A) = \dfrac{5}{25}$, $P(B) = \dfrac{3}{25}$, $P(A \cap B) = \dfrac{0}{25} = 0$

$\therefore$ Required probability $= P(A \cup B)$

$= P(A) + P(B) - P(A \cap B)$

$= \dfrac{5}{25} + \dfrac{3}{25} - 0 = \dfrac{8}{25}$.

**49.** **(a)** $A$: integer chosen is divisible by 6 $B$: Integer chosen is divisible by 8

$n(A)= 33$, $n(B) = 25$, $n(A \cap B) = 8$, $n(S) = 200$

$P(A) = \dfrac{33}{200}$, $P(B) = \dfrac{25}{200}$

$P(A \cap B)= P(A) + A(B) - P(A \cap B)$

$= \dfrac{33}{200} + \dfrac{33}{200} - \dfrac{8}{200} = \dfrac{50}{200} = \dfrac{1}{4}$.

**50.** **(c)** $A$: Sum of two numbers is divisible by 3

$B$: Sum of two numbers is divisible by 4

$A = [(1, 2), (2, 1), (3, 3), (5, 1), (1, 5), (2, 4), (4, 2), (5, 4), (4, 5), (6, 3), (3, 6), 6, 6)]$

$B = [(2, 2), (3, 1), (1, 3), (5, 3), (3, 5), (4, 4), (6, 2), (2, 6), (6, 6)]$

$P(A) = \dfrac{12}{36}$, $P(B) = \dfrac{9}{36}$, $P(A \cap B) = \dfrac{1}{36}$

$\therefore$ Required probability $= P(A \cup B)$

$= P(A) + P(B) - P(A \cap B)$

$= \dfrac{12}{36} + \dfrac{9}{36} - \dfrac{1}{36} = \dfrac{20}{36} = \dfrac{5}{9}$.

**51.** **(a)** $A$: Getting total of 11 $B$: Getting odd number one each die

$A = [(6, 5), (5, 6)]$

$B = [1, 1). (1, 3), (1, 5), (3, 1), (3, 3), (3, 5), (5, 1), (5,3), (5, 5)]$

$P(A) = \dfrac{2}{36}$, $P(B)$, $P(B) = \dfrac{9}{36}$, $P(A \cap B) = \dfrac{9}{36} = 0$

$\therefore$ Required probability $= P(A) + P(B) - P(A \cap B)$

$= \dfrac{2}{36} + \dfrac{9}{36} - 0 = \dfrac{11}{36}$.

**52.** **(b)** $A$: Number divisible by 3 $B$: Number is a perfect square

$A = (3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36)$

$B = (1, 4, 9, 16, 25, 36)$

$P(A) = \dfrac{12}{36}$, $P(B) = \dfrac{6}{36}$, $P(A \cap B) = \dfrac{2}{36}$

$\therefore$ Required probability $= P(A \cup B) = P(A) + P(B) - P(A \cap B)$.

$= \dfrac{12}{36} + \dfrac{6}{36} - \dfrac{2}{36} = \dfrac{16}{36} = \dfrac{4}{9}$.

**53.** **(c)** $A$: Getting rusted item $B$: Getting bolt

$P(A) = \dfrac{100}{200}$, $P(B) = \dfrac{50}{200}$, $P(A \cap B) = \dfrac{125}{200}$

$\therefore$ Required probability $= P(A \cup B)$

$= P(A) + P(B) - P(A \cap B)$

$= \dfrac{100}{200} + \dfrac{50}{200} - \dfrac{25}{200} = \dfrac{125}{200} = \dfrac{5}{8}$.

**54.** **(a)** $A$: Getting, a doublet, $B$: Getting a total of 10

$A = [(1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6)]$

$B = [(6, 4), (4, 6), (5, 5)]$

$P(A) = \dfrac{6}{36}$, $P(B) = \dfrac{3}{36}$, $P(A \cap B) = \dfrac{1}{36}$

$\therefore$ Required probability

$= 1 - P(A \cup B)$

$= 1 - [P(A) + P(B) - P(A \cap B)]$

$= 1 - \left(\dfrac{6}{36} + \dfrac{3}{36} - \dfrac{1}{36}\right)$

$= 1 - \dfrac{8}{36} = \dfrac{28}{36} = \dfrac{7}{9}$.

**55.** **(b)** $A$: Getting a total of 9, $B$: Getting a total of 11

$A = [(5, 4), (4, 5), (6, 3), (3, 6)]$ $B = [(6, 5), (5, 6)]$

$P(A) = \dfrac{4}{36}$, $P(B) = \dfrac{2}{36}$, $P(A \cap B) = \dfrac{0}{36}$

$\therefore$ Required probability $= 1 - P(A \cup B)$

$= [P(A) + P(B) - P(A \cap B)]$

$= 1 - \left(\dfrac{4}{36} + \dfrac{2}{36} - 0\right)$

$= 1 - \dfrac{1}{6} = \dfrac{5}{6}$.

**56.** **(d)** $A$: Getting spade card $B$: Getting ace card $C$: Getting red card

$P(A) = \dfrac{13}{52}$, $P(B) = \dfrac{4}{52}$, $P(C) = \dfrac{26}{52}$, $P(A \cap B) = \dfrac{1}{52}$,

$P(B \cap C) = \dfrac{2}{52}$, $P(C \cap A) = \dfrac{0}{52} = 0$,

$P(A \cap B \cap C) = \dfrac{0}{52} = 0$

$\therefore$ Required probability

$= P(A \cup B \cup C)$

$= P(A) + P(B) + P(C) - P(A \cap B) - P(B \cap C)$

$- P(C \cap A) + P(A \cap B \cap C)$

$= \dfrac{13}{52}+\dfrac{4}{52}+\dfrac{26}{52}-\dfrac{1}{52}-\dfrac{2}{52}-0=\dfrac{40}{52}=\dfrac{10}{13}$.

**57.** **(a)** $A$: Number is divisible by 2 $B$: Number is divisible buy 3 $C$: Number is divisible by 5

$P(A) = \dfrac{100}{200}$, $P(B) = \dfrac{66}{200}$, $P(C) = \dfrac{40}{200}$,

$P(B \cap C)$ $\dfrac{33}{200}$ $= P(B \cap C) = \dfrac{13}{200}$,

$P(C \cap A) = \dfrac{20}{200}$, $P(A \cap B \cap C) = \dfrac{6}{200}$

$\therefore$ Required probability

$= P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(B \cap C)$

$- P(C \cap A) + P(A \cap B \cap C)$

$= \dfrac{100}{200}+\dfrac{66}{200}+\dfrac{40}{200}-\dfrac{33}{200}-\dfrac{13}{200}-\dfrac{20}{200}+\dfrac{6}{200}=\dfrac{146}{200}=\dfrac{73}{200}$.

**58.** **(b)** We know $P(A) = 1 - P(\bar{A})$

$= 1 - 0.65 = 0.35$

and, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$\Rightarrow$ $0.65 = 0.35 + p - 0$

[$\because$ $A$ and $B$ are mutually exclusive events]

$\Rightarrow$ $p = 0.65 - 0.35 = 0.30$.

**59.** **(a)** Required probability $= 1 - P(A \cup B)$

$= 1 - [P(A) + P(B) - P(A \cap B)$

$= 1 - [0.5 + 0.3 - 0]$

[$\because$ $A$ and $B$ are mutually exclusive events]

$= 1 - 0.8 = 0.2$.

**60.** **(c)** $P(\text{at least } B \text{ grade}) = P(B \text{ grade}) + P(A \text{ grade})$

$= 0.38 + 0.30 = 0.68$

**61.** **(c)** $A$: Contractor will get a plumbing contract

$B$: Contractor will get an electric contract

$P(A) = \dfrac{5}{9}$, $P(\bar{B}) = \dfrac{5}{9}$, $P(A \cup B) = \dfrac{4}{5}$

We know, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$\Rightarrow$ $\dfrac{4}{5}=\dfrac{2}{3}$ $+ [1 - P(\bar{B})] - P(A \cap B)$

$\Rightarrow$ $\dfrac{4}{5}=\dfrac{2}{3}$ $+ 1 -$ $\dfrac{5}{9}$ $- P(A \cap B)$

$\Rightarrow$ $(A \cap B) = \dfrac{2}{3}+1-\dfrac{5}{9}-\dfrac{4}{5}$

$= \dfrac{30+45-25-26}{45}=\dfrac{14}{45}$.

**62.** **(a)** Let, $A$: a spade is drawn and $B$: an ace is drawn

Probability of winning the bet $= P(A \text{ or } B)$

$= P(A) + P(B) - P(A \text{ and } B)$

$= \dfrac{13}{52}+\dfrac{4}{52}-\dfrac{1}{52}=\dfrac{16}{52}=\dfrac{4}{52}$

Probability of losing the bet $= 1- \dfrac{4}{13}=\dfrac{9}{13}$

Odds against winning the bet $= \dfrac{9}{13}:\dfrac{4}{13}$ $= 9:4$.

**63.** **(b)** $A$:$A$ wins the race $B$:$B$ wins the race $C$: $C$ wins the race

$P(A) = \dfrac{1}{1+3}=\dfrac{1}{4}$, $P(B) = \dfrac{1}{1+4}=\dfrac{1}{5}$,

$P(C) = \dfrac{1}{1+5}=\dfrac{1}{6}$, $P(D) = \dfrac{1}{1+6}=\dfrac{1}{7}$

$\therefore$ Required probability $= P(A) + P(B) + P(C) + P(D)$

$= \dfrac{1}{4}+\dfrac{1}{5}+\dfrac{1}{6}+\dfrac{1}{7}=\dfrac{319}{420}$.

**64.** **(b)** Let, $A$ and $B$ denote the events that the chartered accountant is selected in firms $X$ and $Y$, respectively. Then,

$P(A) = 0.7$, $P(\bar{B}) = 0.5$ and $P(\bar{A} \cup \bar{B}) = 0.6$

Now, $P(\bar{A}) = 1 - P(A) = 1 - 0.7 = 0.3$

$P(B) = 1 - P(\bar{B}) = 1 - 0.5 = 0.5$

Again, $\overline{A \cap B} = \overline{A \cup B}$ (By De Morgan's law)

$\therefore$ $P(A \cap B) = 1 - P\,\overline{A \cap B} = 1 - P(\bar{A} \cup \bar{B})$

$\Rightarrow$ $P(A \cap B) = 1 - 0.6 = 0.4$

$\therefore$ $P(A \cup B) = 0.7 + 0.5 - 0.4 = 0.8$

Hence, the probability that the chartered accountant will be selected in one of the two firms $X$ or $Y$ is 0.8.

**65.** **(a)** Since odds against the event $A$ are 8:3, the probability of the happening of the event $A$ is given by $P(A) = \dfrac{3}{8+3}=\dfrac{3}{11}$.

Similarly, odds against the event $B$ are 5:2, so we have

$P(B) = \dfrac{2}{5+2}=\dfrac{2}{7}$.

Since the events $A$, $B$, $C$ are such that one of them is a must and only one can happen, so the events $A$, $B$, $C$ are mutually exclusive and exhaustive and consequently the sum of their probability must be 1.

$\therefore$ $P(A) + P(B) + P(C) = 1$ or $\dfrac{3}{11}+\dfrac{2}{7}$ $+ P(C) = 1$

$\Rightarrow$ $P(C) = 1 - \dfrac{3}{11}-\dfrac{2}{7}=\dfrac{34}{77}$.

$\therefore$ $P(\bar{C}) = 1 - P(C) = 1 - \dfrac{34}{77}=\dfrac{43}{77}$.

$\therefore$ The odds against $C$ are 43:34.

**66.** **(b)** Probability that $A$ fails to solve the problem is $1 - \frac{1}{3} = \frac{2}{3}$

Probability that $B$ fails to solve the problem is $1 - \frac{1}{4} = \frac{3}{4}$

Probability that $C$ fails to solve the problem is $1 - \frac{1}{5} = \frac{4}{5}$.

Probability that $D$ fails to solve the problem is $1 - \frac{1}{6} = \frac{5}{6}$.

Since the events are independent, the probability that all the four students fail to solve the problem is $\frac{2}{3} \times \frac{3}{4} \times \frac{4}{5} \times \frac{5}{6} = \frac{1}{3}$.

$\therefore$ The probability that the problem will be solved $= 1 - \frac{1}{3} = \frac{2}{3}$.

**67.** **(c)** Probability of drawing a white ball from the first bag $= \frac{4}{5} = \frac{2}{3}$. Probability of drawing a white ball from the second bag $= \frac{3}{8}$.

Since the events are independent, the probability that both the balls are white $= \frac{2}{3} \times \frac{3}{8} = \frac{1}{4}$.

**68.** **(a)** Probability of drawing a black ball from first bag $= \frac{2}{6} = \frac{1}{3}$

Probability of drawing a black ball from the second bag $= \frac{5}{8}$.

$\therefore$ Probability that both balls are black $= \frac{1}{3} \times \frac{5}{8} = \frac{5}{24}$.

**69.** **(c)** The event 'one is white and one is black' is the same as the event 'either the first is white and the second is black or the first is black and the second is white',

$\therefore$ The probability that one is white and one is black $= \frac{2}{3} \times \frac{5}{8} \times \frac{1}{3} \times \frac{3}{8} = \frac{12}{24}$.

**70.** **(a)** Success: Getting odd number $p = \frac{13}{25}$

$\Rightarrow \quad q = 1 - p = 1 - \frac{13}{25} = \frac{12}{25}$

$P$(two successes) $= pp = \frac{13}{25} \times \frac{13}{25} = \frac{169}{625}$.

**71.** **(b)** $P$(exactly one success) $= pq + qp$

$= \frac{13}{25} \times \frac{12}{25} \times \frac{12}{25} \times \frac{13}{25} = \frac{156 + 156}{625} = \frac{312}{625}$.

**72.** **(c)** $P$(at one success) = 1 $P$(no success)

$= 1 - qq = 1 - \left(\frac{12}{25}\right)\left(\frac{12}{25}\right) = 1 - \frac{144}{625}$

$= \frac{625 - 144}{625} = \frac{481}{625}$.

**73.** **(d)** $P$(no success) $= qq = \frac{12}{25}\left(\frac{12}{25}\right) = \frac{144}{625}$.

**74.** **(a)** Success: getting 5 or 6 $p = \frac{2}{6} = \frac{1}{3}$

$\Rightarrow \quad q = 1 - p = 1 - \frac{1}{3} = \frac{2}{3}$

$P$(3 successes) $= \frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} = \frac{1}{27}$.

**75.** **(b)** $P$(exactly 2 successes) $= ppq + pqp + qpp$

$= \frac{1}{3} + \frac{1}{3} \times \frac{2}{3} + \frac{1}{3} \times \frac{2}{3} \times \frac{1}{3} + \frac{2}{3} \times \frac{1}{3} \times \frac{1}{3}$

$= \frac{2 + 2 + 2}{27} = \frac{6}{27} = \frac{2}{9}$.

**76.** **(c)** $P$(at most 2 successes) $= P$(no success) $+ P$(1 success) $+ P$ (2 successes)

$= 1 - P$(3 successes) $= 1 - pp$

$= 1 - \frac{1}{3}\left(\frac{1}{3}\right)\left(\frac{1}{3}\right) = 1 - \frac{1}{27} = \frac{26}{27}$.

**77.** **(d)** $P$(at least 2 successes) = + $P$(3 successes)

$= ppq + pqp + qpp + ppp$

$= \frac{1}{3} \times \frac{1}{3} \times \frac{2}{3} + \frac{1}{3} \times \frac{2}{3} \times \frac{1}{3} + \frac{2}{3} \times \frac{1}{3} \times \frac{1}{3} + \frac{1}{3} \times \frac{1}{3} \times \frac{1}{3}$

$= \frac{2 + 2 + 2 + 1}{27} = \frac{7}{27}$.

**78.** **(c)** $A$: First card is diamond card $B$: Second card is king card

$P(A) = \frac{13}{52} = \frac{1}{4}$, $P(B) = \frac{4}{52} = \frac{1}{13}$

$\therefore$ Required probability $= P(A)\ P(B) = \frac{1}{4} \times \frac{1}{13} = \frac{1}{52}$.

**79.** **(a)** $A$: Husband selected; $B$: Wife selected

$P(A) = \frac{1}{7} \quad \Rightarrow \quad (\bar{A}) = 1 - P(A) = 1 - \frac{1}{7} = \frac{6}{7}$

$P(B) = \frac{6}{7} \quad \Rightarrow \quad P(\bar{B}) = 1 - P(B) = 1 - \frac{1}{5} = \frac{4}{5}$

$P$(only one of them will be selected)

$= P(A)\ P(\bar{B}) + P(B)\ P(\bar{A})$

$= \frac{1}{7}\left(\frac{4}{5}\right) + \frac{1}{5}\left(\frac{6}{7}\right) = \frac{4 + 6}{35} = \frac{10}{35} = \frac{2}{7}$.

**80.** **(b)** $P$(both of them will be selected)

$= P(A) \times P(B) = \frac{1}{7} \times \frac{1}{5} = \frac{1}{35}$.

**81.** **(c)** $P$(none of them will be selected)

$= P(\bar{A})\ P(\bar{B}) = \frac{6}{7} \times \frac{4}{5} = \frac{24}{35}$.

**82.** **(d)** $P$(at least one of them will be selected)

$= 1 - P(\bar{A}) \times P(\bar{B})$

$= 1 - \frac{6}{7}\times\frac{4}{5} = 1-\frac{24}{35} = \frac{11}{35}$.

**83.** **(a)** $A$: Husband will be alive 25 years hence

$B$: Wife will be alive 25 years hence

$P(A) = 0.3 \Rightarrow P(\bar{A}) = 1 - P(A) = 1.03 = 0.7$

$P(B) = 0.4 \Rightarrow P(\bar{B}) = 1 - P(B) = 1 - 04 = 0.6$

Required probability $= P(A)\ P(B) = (0.3)\ (0.4) = 0.12$.

**84.** **(b)** Required probability $= P(A)\ P(\bar{B}) = (0.3)\ (0.6) = 0.18$.

**85.** **(c)** Required probability $= P(B)\ P(A) = (0.4)\ (0.7) = 0.28$.

**86.** **(d)** Required probability $= 1 - P(\bar{A})\ P(\bar{B})$

$= 1 - (0.7)\ (0.6)$

$= 1 - 0.42 = 0.58$.

**87.** **(b)** Let, the two men be $A$ and $B$. $A$:$A$ speaks truth; $B$:$B$ speaks truth

$P(A) = \frac{80}{100} \Rightarrow P(\bar{A}) = 1 - P(A) = 1-\frac{80}{100} = \frac{20}{100}$

$P(B) = \frac{90}{100} \Rightarrow P(\bar{B}) = 1 - P(B) = 1-\frac{90}{100} = \frac{10}{100}$

$\therefore$ Required probability $= P(A)\ P(\bar{B}) + P(B)\ P(\bar{A})$

$= \frac{80}{100}\times\frac{10}{100}+\frac{90}{100}\times\frac{20}{100}$

$= \frac{8+18}{100} = \frac{26}{100} = \frac{13}{50}$.

**88.** **(a)** $A$: Getting a red ball from urn $A$

$B$: Getting a black ball from urn $A$

$C$: Getting a red ball from urn $B$

$D$: Getting a black ball fron urn $C$

$E$: Getting a red ball from urn $C$

$F$: Getting a black ball from urn $C$

$P(A) = \frac{4}{7}$, $P(B) = \frac{3}{7}$, $P(C) = \frac{5}{9}$,

$P(D) = \frac{4}{9}$, $P(E) = \frac{4}{8}$. $P(F) = \frac{4}{8}$

Required probability $= P(A)P(C)P(F)+P(A)P(D)\ P(E) + P(B)P(C)P(E)$

$= \frac{4}{5}\times\frac{5}{9}\times\frac{4}{8}+\frac{4}{9}\times\frac{4}{8}+\frac{3}{7}\times\frac{5}{9}\times\frac{4}{8}$

$= \frac{80+64+60}{504} = \frac{204}{504} = \frac{17}{42}$.

**89.** **(c)** $A$: Plane is hit by the first shot

$B$: Plane is hit by the second shot

$C$: Plane is hit by the third shot

$D$: Plane is hit by the fourth shot

$P(A) = 0.4 \Rightarrow P(\bar{A}) = 1 - P(A) = 1 - 0.4 = 0.6$

$P(B) = 0.3 \Rightarrow P(\bar{B}) = 1 - P(B) = 1 - 0.3 = 0.7$

$P(C) = 0.2 \Rightarrow P(\bar{C}) = 1 - P(C) = 1 - 0.2 = 0.8$

$P(D) = 0.1 \Rightarrow P(\bar{D}) = 1 - P(D) = 1 - 0.1 = 0.9$

$\therefore$ Required probability

$= 1-P(\bar{A})P(\bar{B})P(\bar{C})P(\bar{D})$

$= 1 - (0.6)\ (0.7)\ (0.8)\ (0.9)$

$= 1 - 0.3024 = 0.6976$.

**90.** **(b)** $A$:$A$ solves the problem; $B$:$B$ solves the problem.

$P(A) = \frac{90}{100} \Rightarrow P(\bar{A}) = 1 - P(A) = 1 - \frac{90}{100} = \frac{10}{100}$

$P(B) = \frac{70}{100} \Rightarrow P(\bar{B}) = 1 - P(B) = 1 - \frac{70}{100} = \frac{30}{100}$

Required probability $= 1-P(\bar{A})P(\bar{B})$

$= 1-\frac{10}{100}\times\frac{30}{100} = 1\frac{3}{100}$

$= \frac{97}{100}$.

**91.** **(b)** Success: Getting head

$\therefore\ p = \frac{1}{2}$

$\Rightarrow\ q = 1 - p = 1-\frac{1}{2} = \frac{1}{2}$.

Let, $A$ start the game. $A$ can win the game in 1st, IIIrd, Vth, ... throws. Then

$P(A$ winning$) = p + qqp + qqqqp + ...$

$= p[1 + q^2 + q^4 + ...]$

$= p\frac{1}{1-q^2} = \frac{1}{2}\frac{1}{1-(1/2)^2}$

$= \frac{4}{2(3)} = \frac{2}{3}$.

**92.** **(a)** Success: Getting 6

$p = \frac{1}{6} \Rightarrow q = 1 - p = 1-\frac{1}{6} = \frac{5}{6}$.

$A$ can win the game in 1st, IIIrd, Vth ... throws

$P(A$ winning$) = p + qqp + qqqqp + ...$

$= p[1 + q^2 + q^4 + ...] = p\frac{1}{1-q^2}$

$= \frac{1}{6}\frac{1}{1-(5/6)^2} = \frac{1}{6}\frac{36}{36-25} = \frac{6}{11}$

$\therefore\ P(B$ winning$) = 1-\frac{6}{11} = \frac{5}{11}$.

**93.** **(d)** $A$: Three vowels come together

$n(A) = 5!3!,\quad n(S) = 7!$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{5!3!}{7!}$

$= \dfrac{3\times 2}{7\times 6} = \dfrac{1}{7}$.

**94.** **(a)** $A{:}D$ occupies the first place

$n(A) = 7!$, $n(S) = 8!$

$\therefore$ Required probability = $P(A) = \dfrac{n(A)}{n(S)} = \dfrac{7!}{8!} = \dfrac{1}{8}$.

## EXERCISE-2
## (BASED ON MEMORY)

**1.** **(c)** $P$ (at least one red) 1 – P (no red)

$= 1 - \dfrac{{}^5C_3}{{}^{10}C_3} = 1 - \dfrac{10}{120} = 1 - \dfrac{1}{12} = \dfrac{11}{12}$

**2.** **(b)** $P$ (2 green + 2 blue)

$= \dfrac{{}^2C_2 \times {}^2C_2}{{}^{10}C_3} = \dfrac{1\times 3}{210} = \dfrac{1}{70}$

**3.** **(b)** Number of ways of selecting 4 students out of 15 students = ${}^{15}C_4 = \dfrac{15\times 14\times 3\times 12}{1\times 2\times 3\times 4}$ = 1365.

The number of ways of selecting 4 students in which no student belongs to Karnataka = ${}^{10}C_4$

$\therefore$ No of ways of selecting at least 1 student from Karnataka = ${}^{15}C_4 - {}^{10}C_4 = 1155$.

$\therefore$ Required probability = $\dfrac{1155}{1365} = \dfrac{77}{91} = \dfrac{11}{13}$.

**4.** **(b)** The probabilty that a student is absent in the class $= \dfrac{2}{6} = \dfrac{1}{3}$.

$\therefore$ The probability of missing his test will be

$= \dfrac{1}{5} \times \dfrac{1}{3} = \dfrac{1}{15}$.

**5.** **(a)**

**6.** **(e)** Clearly, the ball picked up must be blue, which can be picked in ${}^7C_1 = 7$ ways.

One ball can be picked from total (8 + 7 + 6 = 21) in ${}^{21}C_1$ ways.

$\therefore$ Required probability = $\dfrac{7}{21} = \dfrac{1}{3}$.

**7.** **(b)** $n(S)$ = Number of ways to select 3 marbles out of 7 marbles = ${}^7C_3$

$= \dfrac{7\times 6\times 5}{1\times 2\times 3} = 35$

$n(E)$ = Probability that 2 are green and 1 is red

$= {}^4C_2 \times {}^3C_1 = \dfrac{4\times 3}{1\times 2}\times 3 = 18$

Required probability = $\dfrac{n(E)}{n(S)} = \dfrac{18}{35}$

**8.** **(d)** Probability to be a Blue = $\dfrac{{}^3C_3}{{}^7C_3}$

Probability to be a Red = $\dfrac{{}^4C_3}{{}^7C_3}$

Required probability = $\dfrac{{}^3C_3}{{}^7C_3} + \dfrac{{}^4C_3}{{}^7C_3} = \dfrac{2}{35}$

**9.** **(d)** Total numbers of balls = 13 + 7 = 20

Number of sample space = $n(S) = {}^{20}C_2 = 190$

Number of events = $n(E) = {}^{13}C_2 + {}^7C_2 = 78 + 21 = 99$

$\therefore\ P(E) = \dfrac{n(E)}{n(S)} = \dfrac{99}{190}$

**10.** **(e)** Total number of marbles in the urn

= 4 + 5 + 2 + 3 = 14

Total number of possible outcomes

= Selection of 2 marbles out of 14 marbles

$= {}^{14}C_2 = \dfrac{14\times 13}{1\times 2} = 91$

Total number of favourable cases

$= {}^2C_2 + {}^2C_1 + {}^{12}C_1 = 1 + 2\times 12 = 25$

$\therefore$ Required probability $= \dfrac{25}{91}$

**11.** **(b)** Total number of possible outcomes

$= {}^{14}C_3 = \dfrac{14\times 13\times 12}{1\times 2\times 3} = 364$

When no marbles is yellow, favourable number of cases

$= {}^{11}C_3 = \dfrac{11\times 10\times 9}{1\times 2\times 3} = 165$

$\therefore$ Probability that no marble is yellow $= \dfrac{165}{364}$

$\therefore$ Required probability = (Probability that at least 1 is yellow) = (1 – Probability that no marble is yellow)

$= 1 - \dfrac{165}{364} = \dfrac{364 - 165}{364} = \dfrac{199}{364}$

**12.** **(c)** Total possible outcomes $= {}^{14}C_8 = {}^{14}C_6$ $[\because {}^nC_r = {}^nC_{n-r}]$

$= \dfrac{14\times 13\times 12\times 11\times 10\times 9}{1\times 2\times 3\times 4\times 5\times 6} = 3003$

Total number of favourable cases

$= {}^4C_2 \times {}^5C_2 \times {}^2C_2 \times {}^3C_2 = 6 \times 10 \times 1 \times 3 = 180$

$\therefore$ Required probability $= \dfrac{180}{3003} = \dfrac{60}{1001}$

**13.** **(e)** Total number of possible outcomes

$= {}^{14}C_3 = \dfrac{14 \times 13 \times 12}{1 \times 2 \times 3} = 364$

Now, according to the question, no marble should be green.

$\therefore$ Total number of favourable outcomes

= Selection of 3 marbles out of 5 blue, 2red and 3 yellow marbles

$= {}^{10}C_3 = \dfrac{10 \times 9 \times 8}{1 \times 2 \times 3} = 120$

$\therefore$ Required probability $= \dfrac{120}{364} = \dfrac{30}{91}$

**14.** **(a)** Total number of possible outcomes

$= {}^{14}C_4 = \dfrac{14 \times 13 \times 12 \times 11}{1 \times 2 \times 3 \times 4} = 1001$

Total number of favourable cases

$= {}^5C_2 \times {}^2C_2 = 10 \times 1 = 10$

$\therefore$ Required probability $= \dfrac{10}{1001}$

**15.** **(a)** Total number of ways of selecting 4 children out of 8

$= {}^8C_4 = \dfrac{8 \times 7 \times 6 \times 5}{1 \times 2 \times 3 \times 4} = 70$

Number of ways of selecting 4 girls out of 5 = ${}^5C_4 = 5$

Required probability $= \dfrac{5}{70} = \dfrac{1}{14}$

**16.** **(d)** $n(s)$ = Total possible outcomes

= Number of ways of picking 3 marbles out of 12

$= {}^{12}C_3 = \dfrac{12 \times 11 \times 10}{3 \times 2 \times 1} = 220$

$n(E)$ = Favourable no. of cases

$= {}^3C_3 + {}^4C_3 = 1 + 4 = 5$

Required probability $= \dfrac{n(E)}{n(s)} = \dfrac{5}{220} = \dfrac{1}{44}$.

**17.** **(e)** $n(s)$ = Total possible outcomes

$= {}^{12}C_2 = \dfrac{12 \times 11}{1 \times 2} = 66$

$n(E)$ = Favourable number of cases

$= {}^4C_2 = \dfrac{4 \times 3}{1 \times 2} = 6$

Required probability $= \dfrac{n(E)}{n(s)} = \dfrac{6}{66} = \dfrac{1}{11}$.

**18.** **(b)** $n(s)$ =Total possible outcomes

$= {}^{12}C_3 = 220$

$n(E)$ =Favourable number of cases

= Number of ways of picking 3 marbles (none is blue)out of 7

$= {}^7C_3 = \dfrac{7 \times 6 \times 5}{1 \times 2 \times 3} = 35$

Required probability $= 1 - \dfrac{35}{220} = 1 - \dfrac{7}{44} = \dfrac{37}{44}$.

**19.** **(a)** Required probability is when all caps chosen are blue, red or yellow. Which is equal to

$\dfrac{{}^7C_4}{{}^{12}C_4} = \dfrac{7!\,4!\,8!}{4!\,3!\,12!} = \dfrac{7}{99}$.

**20.** **(e)** Required probability

$= \dfrac{{}^2C_2}{{}^{12}C_2} = \dfrac{2!}{2!\,0!} \Big/ \dfrac{12!}{10!\,2!} = \dfrac{1}{66}$

**21.** **(b)** Required probability

$= ({}^2C_1 + {}^1C_1) / {}^{12}C_1 = \dfrac{3}{12} = \dfrac{1}{4}$

**22.** **(c)** Required probability

$= \dfrac{1}{{}^{12}C_2}({}^4C_1 \times {}^8C_1 + {}^4C_2) = \dfrac{38}{12 \times 11} \times 2 = \dfrac{19}{33}$

**23.** **(d)** Required probability

$= ({}^4C_2 \times {}^5C_1) / {}^{12}C_3 = \dfrac{3}{22}$

# Mensuration I: Area and Perimeter

# 33

## INTRODUCTION

In this chapter, we shall be dealing with plane figures of various shapes by finding their sides, perimeters and areas.

**Area:**

The area of any figure is the amount of surface enclosed within its boundary lines. Area is always expressed in square units.

**Units of Measuring Area**

100 sq millimetres = 1 sq centimetre

100 sq centimetres = 1 sq decimetre

100 sq decimetres = 1 sq metre

100 sq metres = 1 sq decametre or arc

10,000 sq metres = 1 hectare

1,000,000 sq metres = 100 hectares

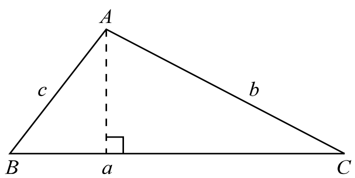
= 1 sq kilometre

### Perimeter

The perimeter of a geometrical figure is the total length of the sides enclosing the figure.

## SOME BASIC FACTS

**1. Triangle**




A *triangle* is a closed figure bounded by three sides. Here, $ABC$ is a triangle.

The sides $AB$, $BC$ and $AC$ are denoted by $c$, $a$ and $b$. respectivlely

Area of a Triangle ($A$)

(a) $A = \frac{1}{2}$ (base × height) $= \frac{1}{2}ah$

(b) $A = \sqrt{s(s-a)(s-b)(s-c)}$,

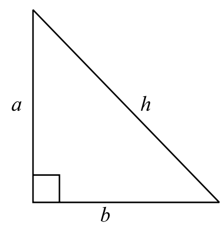
Where $s = \frac{1}{2}(a+b+c)$ or semi-perimeter of the triangle.

This formula is known as *Hero's formula*.

Perimeter ($P$) = $a + b + c = 2s$.

**2. Right Angled Triangle**

A triangle having one of its angles equal to 90° is called a *right-angled triangle*. The side opposite to the right angle is called the *hypotenuse*.




In a right angled triangle,

(Hypotenuse)$^2$ = Sum of the squares of sides

i.e., $h^2 = a^2 + b^2$.

Area ($A$) = $\frac{1}{2}$(product of the sides containing the right angle)

i.e., $A = \frac{1}{2}ab$.

**Illustration 1:** What is the area of a triangle having sides 3 m, 4 m and 5 m?

**Solution:** Let $a$ = 3 m, $b$ = 4 m, $c$ = 5 m.

Then, $s = \dfrac{a+b+c}{2} = \dfrac{3+4+5}{2} = 6$ m.

$\therefore$ Area $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{6(6-3)(6-4)(6-5)}$

$= \sqrt{6\times3\times2\times1} = \sqrt{36} = 6\text{ m}^2$

**Illustration 2:** Find the area of a triangle whose base is 4.6 m and height is 67 cm.

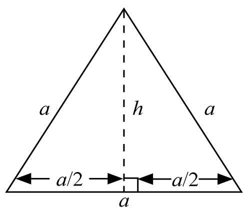
**Solution:** Area of the triangle $= \dfrac{1}{2}$(base × height)

$= \dfrac{1}{2}(4.6 \times 100 \times 67)$

$= 15410\text{ cm}^2$

**3. Equilateral Triangle**

A triangle whose all sides are equal is called an equilateral triangle.




Area ($A$) of an equilateral triangle

$$= \frac{\sqrt{3}}{4}(\text{side})^2 = \frac{\sqrt{3}}{4}a^2$$

Permeter ($P$) of an equilateral triangle

$$= 3 \times (\text{side}) = 3a$$

Altitude ($h$) of an equilateral triangle

$$= \frac{\sqrt{3}}{2} \times (\text{side}) = \frac{\sqrt{3}}{2}a.$$

In an equilateral triangle

$$\angle A = \angle B = \angle C = 60°.$$

Area ($A$) of an equilateral triangle

$$= \frac{(\text{altitude})^2}{\sqrt{3}} = \frac{h^2}{\sqrt{3}}.$$

**Illustration 3:** Find the area of an equilateral triangle each of whose sides measures 6 cm.

**Solution:** Area of the equilateral triangle

$$= \frac{\sqrt{3}}{4}(\text{side})^2 = \frac{\sqrt{3}}{4} \times 36 = 9\sqrt{3}\text{ cm}^2.$$

**Illustration 4:** Length of the side of an equilateral triangle is $\dfrac{4}{\sqrt{3}}$ cm. Find its height.

**Solution:** Height of the equilateral triangle

$$= \frac{\sqrt{3}}{2} \times (\text{side})$$

$$= \frac{\sqrt{3}}{2} \times \frac{4}{\sqrt{3}} = 2\text{ cm}.$$

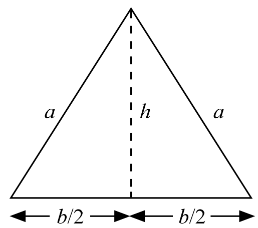
**Illustration 5:** Height of an equilateral triangle is $4\sqrt{3}$ cm. Find its area.

**Solution:** Area of the equilateral triangle

$$= \frac{(\text{altitude})^2}{\sqrt{3}} = \frac{4\sqrt{3}\times4\sqrt{3}}{\sqrt{3}} = 16\sqrt{3}\text{ cm}^2.$$

**4. Isosceles Triangle**

A triangle whose two sides are equal is called an *isosceles triangle*.




Area ($A$) of an isosceles triangle

$$= \frac{b}{4}\sqrt{4a^2 - b^2}$$

Perimeter ($P$) of an isosceles triangle

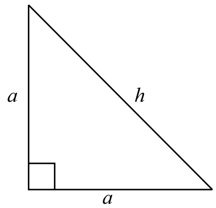
$$= (2a + b)$$

Height ($h$) of an isosceles triangle

$$= \frac{1}{2}\sqrt{4a^2 - b^2}.$$

**5. Isosceles Right-angled Triangle**

An *isosceles right-angled triangle* has two sides equal with equal sides making 90° to each other.




Hypotenuse ($h$) = $\sqrt{2}a$

Area ($A$) = $\frac{1}{2}a^2$

Perimeter ($P$) = $2a + \sqrt{2}a = \sqrt{2}a(\sqrt{2}+1)$

$= h(\sqrt{2}+1)$.

If the perimeter of an isosceles triangle is $P$ and the base is $b$, then the length of the equal sides is $\left(\frac{P-b}{2}\right)$.

If the perimeter of an isosceles triangle is $P$ and the length of equal sides is $a$, then base is $(P - 2a)$.

**Illustration 6:** An isosceles right-angled triangle has two equal sides of length 6 m each. Find its area.

**Solution:** Area = $\frac{1}{2}$ (equal side)$^2$ = $\frac{1}{2}$ $(6)^2$ = 18 m$^2$.

**Illustration 7:** The perimeter of an isosceles triangle is 80 cm. If the length of the equal sides is 15 cm, find the length of the base.

**Solution:** Length of the base = $P - 2a$

$= 80 - 2(15) = 50$ cm.

**Illustration 8:** The perimeter of an isosceles triangle is 42 cm. If the base is 16 cm, find the length of the equal sides.

**Solution:** The length of the equal sides = $\frac{P-b}{2}$.

$= \frac{42-16}{2} = \frac{26}{2} = 13$ cm.

**Illustration 9:** If the base of an isosceles triangle is 10 cm and the length of the equal sides is 13 cm, find its area.

**Solution:** Area of the isosceles triangle

$= \frac{b}{4}\sqrt{4a^2-b^2}$

$= \frac{10}{4}\sqrt{4\times(13)^2-(10)^2}$

$= \frac{10}{4}\sqrt{676-100} = \frac{10}{4}\times 24 = 60$ cm$^2$.

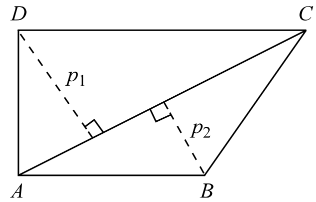
**6. Quadrilateral**

A closed figure bounded by four sides is called a *quadrilateral*.

It has four angles included in it.

The sum of these four angles is 360°.

i.e., $\angle A + \angle B + \angle C + \angle D = 360°$.




Area ($A$) of a quadrilateral

$= \frac{1}{2} \times$ one diagonal $\times$ (sum of the perpendiculars to it from opposite vertices)

$= \frac{1}{2}d(p_1+p_2)$

***Note:***

If the lengths of four sides and one of its diagonals are known, then,

$A$ = Area of $\Delta ADC$ + Area of $\Delta ABC$.

The special cases of quadrilateral are parallelogram, rectangle, square, rhombus, trapezium, etc., which are discussed below separately.

**7. Parallelogram**

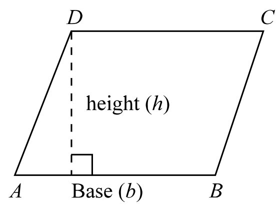
A quadrilateral in which opposite sides are equal and parallel is called a parallelogram.

The diagonals of a parallelogram bisect each other.

Area ($A$) of a parallelogram

= base $\times$ altitude corresponding to the base

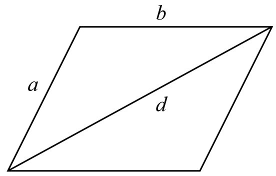
$= b \times h$



Area ($A$) of a parallelogram

$$= 2\sqrt{s(s-a)(s-b)(s-d)}$$

where $a$ and $b$ are adjacent sides, $d$ is the length of the diagonal connecting the ends of the two sides and $s = \dfrac{a+b+d}{2}$.




In a parallelogram, the sum of the squares of the diagonals = 2 (the sum of the squares of the two adjacent sides),

i.e., $d_1^2 + d_2^2 = 2(a^2 + b^2)$.

Perimeter ($P$) of a parallelogram

$$= 2(a + b),$$

where $a$ and $b$ are adjacent sides of the parallelogram.

**Illustration 10:** One side of a parallelogram is 15 cm and the corresponding altitude is 5 cm. Find the area of the parallelogram.

**Solution:** Area of the parallelogram

$$= \text{base} \times \text{corresponding altitude}$$

$$= 15 \times 5 = 75 \text{ cm}^2.$$

**Illustration 11:** In a parallelogram, the lengths of the adjacent sides are 11 cm and 13 cm, respectively. If the length of one diagonal is 20 cm then, find the length of the other diagonal.

**Solution:** We have,

$$d_1^2 + d_2^2 = 2(a^2 + b^2)$$

$$\Rightarrow (20)^2 + d_2^2 = 2(11^2 + 13^2)$$

$$\Rightarrow d_2^2 = 2(121 + 169) - 400 = 180.$$

$$\therefore d_2 = \sqrt{180} = 13.4 \text{ m (approx.)}$$

**Illustration 12:** Find the area of a quadrilateral of whose diagonal is 38 cm long and the lengths of perpendiculars from the other two vertices are 31 cm and 19 cm, respectively.

**Solution:** Area of the quadrilateral

$$= \frac{1}{2} d(p_1 + p_2)$$

$$= \frac{1}{2} \times 38 \times (31 + 19)$$

$$= 19 \times 50 = 950 \text{ cm}^2.$$

**Illustration 13:** Find the area of a parallelogram whose two adjacent sides are 130 m and 140 m and one of the diagonals is 150 m long.

**Solution:** Here, $a$ = 130 m, $b$ = 140 m and $d$ = 150 m

$$\therefore \quad s = \frac{a+b+d}{2} = \frac{130+140+150}{2} = \frac{420}{2} = 210 \text{ m}$$

$\therefore$ Area of the parallelogram

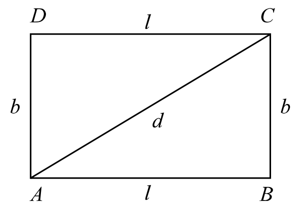
$$= 2\sqrt{s(s-a)(s-b)(s-a)}$$

$$= 2\sqrt{210(210-130)(210-140)(210-150)}$$

$$= 2\sqrt{210\times 80\times 70\times 60} = 2 \times 8400 \text{ m}^2.$$

### 8. Rectangle

A *rectangle* is a quadrilateral with opposite sides equal and all the four angles equal to 90°.




The diagonals of a rectangle bisect each other and are equal.

(a) Area ($A$) of a rectangle = length × breadth

$$= l \times b$$

or,

Area of a rectangle = $(l\times\sqrt{d^2-l^2})$,

if one side ($l$) and diagonal ($d$) are given.

or,

Area of a rectangle = $\left(\dfrac{p^2}{8}-\dfrac{d^2}{2}\right)$,

if perimeter ($P$) and diagonal ($d$) are given.

(b) Perimeter ($P$) of a rectangle

= 2(length + breadth)

= $2(l + b)$.

or,

Perimeter of a rectangle = $2(l+\sqrt{d^2-l^2})$,

if one side ($l$) and diagonal ($d$) are given.

(c) Diagonal of a rectangle

$$= \sqrt{(\text{length})^2 + (\text{breadth})^2}$$

$$= \sqrt{l^2 + b^2}$$

(d) If area ($A$) and perimeter ($P$) of a rectangle are given, then,

$$\text{length of a rectangle} = \left(\sqrt{\frac{P^2}{16} - A} + \frac{P}{4}\right)$$

and,

$$\text{breadth of a rectangle} = \left(\frac{P}{4} - \sqrt{\frac{P^2}{16} - A}\right)$$

**Illustration 14:** Find the diagonal of a rectangle whose sides are 8 cm and 6 cm.

**Solution:** Diagonal of the rectangle

$$= \sqrt{l^2 + b^2}$$

$$= \sqrt{8^2 + 6^2} = \sqrt{64 + 36}$$

$$= 10 \text{ cm.}$$

**Illustration 15:** Find the perimeter of a rectangle of length 12 m and breadth 6 m.

**Solution:** Perimeter of the rectangle

$$= 2(l + b)$$

$$= 2(12 + 6) = 36 \text{ m.}$$

**Illustration 16:** Calculate the area of a rectangular field whose length is 12.5 cm and breadth is 8 cm.

**Solution:** Area of the rectangular field

$$= l \times b$$

$$= 12.5 \times 8 = 100 \text{ cm}^2.$$

**Illustration 17:** Calculate the area of a rectangular field whose one side is 16 cm and the diagonal is 20 cm.

**Solution:** Area of the rectangular field

$$= (l \times \sqrt{d^2 - l^2})$$

$$= (16 \times \sqrt{20^2 - 16^2})$$

$$= 16 \times 12 = 192 \text{ cm}^2.$$

**Illustration 18:** A rectangular carpet has an area of 120 m$^2$ and perimeter of 46 m. Find the length of its diagonal.

**Solution:** We have,

$$\text{Area of rectangle} = \left(\frac{P^2}{8} - \frac{d^2}{2}\right)$$

$$\Rightarrow \quad 120 = \frac{46^2}{8} - \frac{d^2}{2}$$

$$\Rightarrow \quad 46^2 - 4d^2 = 120 \times 8$$

$$\Rightarrow \quad 4d^2 = 2116 - 960 = 1156$$

$$\therefore \quad d = \sqrt{289} = 17 \text{ m.}$$

**Illustration 19:** The perimeter of a rectangle is 82 cm and its area is 400 m$^2$. Find the length and breadth of the rectangle.

**Solution:** Length of the rectangle

$$= \left(\sqrt{\frac{P^2}{16} - A} + \frac{P}{4}\right)$$

$$= \left(\sqrt{\frac{(82)^2}{16} - 400} + \frac{82}{4}\right)$$

$$= (4.5 + 20.5) = 25 \text{ m.}$$

Breadth of the rectangle

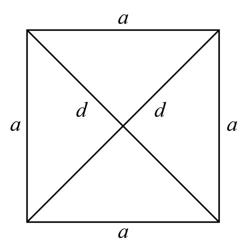
$$= \left(\frac{P}{4} - \sqrt{\frac{P^2}{16} - A}\right)$$

$$= \left(\frac{82}{4} - \sqrt{\frac{(82)^2}{16} - 400}\right)$$

$$= (20.5 - 4.5) = 16 \text{ m.}$$

## 9. Square

A square is a quadrilateral with all sides equal and all the four angles equal to 90°.




The diagonals of a square are equal and bisect each other at 90°.

(a) Area ($A$) of a square

$= a^2$, i.e., (side)$^2$

$= \dfrac{d^2}{2}$, i.e., $\dfrac{(\text{diagonal})^2}{2}$

$= \dfrac{P^2}{16}$, i.e., $\dfrac{(\text{perimeter})^2}{16}$

(b) Perimeter ($P$) of a square

$= 4a$, i.e., $4 \times$ side

$= \sqrt{16 \times \text{area}}$

$= 2\sqrt{2}d$, i.e., $2\sqrt{2} \times$ diagonal

(c) Length ($d$) of the diagonal of a square

$= \sqrt{2}a$, i.e., $\sqrt{2} \times$ side

$= \sqrt{2 \times \text{area}}$

$= \dfrac{P}{2\sqrt{2}}$, i.e., $\dfrac{\text{Perimeter}}{2\sqrt{2}}$.

**Illustration 20:** If the area of a square field is 6050 $m^2$, find the length of its diagonal.

**Solution:** Length of the diagonal of the square field

$= \sqrt{2 \times \text{area}}$

$= \sqrt{2 \times 6050}$

$= \sqrt{12100}$, i.e., 110 m.

**Illustration 21:** Find the area of a square with perimeter 48 m.

**Solution:** Area of the square

$= \dfrac{(\text{Perimeter})^2}{16}$

$= \dfrac{(48)^2}{16} = \dfrac{48 \times 48}{16} = 3 \times 48 = 144$ $m^2$.

**Illustration 22:** Find the diagonal of a square field whose side is 6 m.

**Solution:** Length of the diagonal

$= \sqrt{2} \times$ side

$= 6\sqrt{2}$ m.

**Illustration 23:** In order to fence a square, Ramesh fixed 36 poles. If the distance between the two poles is 6 m, then find the area of the square so formed.

**Solution:** Perimeter of the square

$= 36 \times 6 = 216$ m.

$\therefore$ Area of the square $= \left(\dfrac{\text{Perimeter}}{4}\right)^2$

$= \dfrac{16\sqrt{2}}{2\sqrt{2}} = 54 \times 54$

$= 2916$ $m^2$.

**Illustration 24:** Perimeter of a square field is $16\sqrt{2}$ cm. Find the length of its diagonal.

**Solution:** We have,

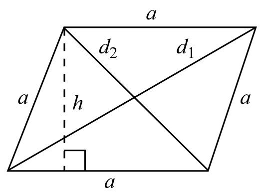
Perimeter of the square field $= 2\sqrt{2} \times$ diagonal

$\Rightarrow$ $16\sqrt{2} = 2\sqrt{2} \times$ diagonal

$\therefore$ Length of the diagonal $= \dfrac{16\sqrt{2}}{2\sqrt{2}} = 8$ cm.

## 10. Rhombus

A *rhombus* is a quadrilateral whose all sides are equal.




The diagonals of a rhombus bisect each other at 90°.

(a) Area ($A$) of a rhombus

$= a \times h$, i.e., base $\times$ height

$= \dfrac{1}{2} d_1 \times d_2$, i.e., $\dfrac{1}{2} \times$ product of its diagonals

$= d_1 \times \sqrt{a^2 - \left(\dfrac{d_1}{2}\right)^2}$,

since, $d_2^2 = 4\left[a^2 - \left(\dfrac{d_1}{2}\right)^2\right]$

$= d_1 \times \sqrt{\left(\dfrac{\text{Perimeter}}{4}\right)^2 - \left(\dfrac{d_1}{2}\right)^2}$,

since, $d_2^2 = 4\left[\left(\dfrac{\text{Perimeter}}{4}\right)^2 - \left(\dfrac{d_1}{2}\right)^2\right]$

(b) Perimeter ($P$) of a rhombus

$$= 4a, \text{ i.e., } 4 \times \text{side}$$

$$= 2\sqrt{d_1^2 + d_2^2},$$

where $d_1$ and $d_2$ are two diagonals.

(c) Side ($a$) of a rhombus

$$= \frac{1}{2}\sqrt{d_1^2 + d_2^2}.$$

**Illustration 25:** The area of a rhombus is 156 m$^2$. If one of its diagonals is 13 m$^2$ then, find the length of the other diagonal.

**Solution:** Area of rhombus $= \frac{1}{2}(d_1 \times d_2)$

$$\Rightarrow \quad 156 = \frac{1}{2}(13 \times d_2)$$

$$\Rightarrow \quad d_2 = \frac{2 \times 156}{13} = 24 \text{ m.}$$

**Illustration 26:** Find the area of a rhombus whose one side is 13 cm and one diagonal is 24 cm.

**Solution:** Area of rhombus $= d_1 \times \sqrt{a^2 - \left(\frac{d_1}{2}\right)^2}$

$$= 24 \times \sqrt{(13)^2 - \left(\frac{24}{2}\right)^2}$$

$$= 24 \times \sqrt{169 - 144}$$

$$= 24 \times 5$$

$$= 120 \text{ cm}^2.$$

**Illustration 27:** If the perimeter of a rhombus is 73 cm and one of its diagonals is 27.5 cm then, find the other diagonal and the area of the rhombus.

**Solution:** One side of rhombus ($a$) $= \frac{73}{4} = 18.25$ cm.

$$\therefore \quad \text{Other diagonal } (d_2) = 2 \times \sqrt{a^2 - \left(\frac{d_1}{2}\right)^2}$$

$$= 2 \times \sqrt{(18.25)^2 - \left(\frac{27.5}{2}\right)^2}$$

$$= 24 \text{ cm.}$$

$$\therefore \quad \text{Area of rhombus} = \frac{1}{2} \times d_1 \times d_2$$

$$= \frac{1}{2} \times 24 \times 27.5$$

$$= 330 \text{ cm}^2.$$

**Illustration 28:** In a rhombus, the lengths of two diagonals are 18 m and 24 m. Find its perimeter.

**Solution:** Perimeter of the rhombus

$$= 2 \times \sqrt{d_1^2 + d_2^2}$$

$$= 2 \times \sqrt{(18)^2 + (24)^2}$$

$$= 2 \times \sqrt{324 + 576}$$

$$= 2 \times \sqrt{900} = 60 \text{ m.}$$

**Illustration 29:** Find the side of a rhombus, one of whose diagonals measure 4 m and the other 3 m.

**Solution:** Side of the rhombus

$$= \frac{1}{2} \times \sqrt{d_1^2 + d_2^2}$$

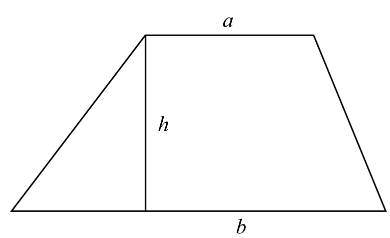
$$= \frac{1}{2} \times \sqrt{(4)^2 + (3)^2}$$

$$= \frac{1}{2} \times 25, \text{ i.e., } 12.5 \text{ m.}$$

### 11. Trapezium (Trapezoid)

A *trapezium* is a quadrilateral whose any two opposite sides are parallel.

Distance between the parallel sides of a trapezium is called its height.




(a) Area ($A$) of a trapezium

$= \frac{1}{2} \times$ (sum of the parallel sides) $\times$ perpendicular distance between the parallel sides

i.e., $\frac{1}{2} \times (a + b) \times h$.

$$= \frac{a+b}{l}\sqrt{s(s-l)(s-c)(s-d)},$$

where, $l = b - a$ if $b > a$

$= a - b$ if $a > b$

and, $s = \dfrac{c+d+l}{2}$

(b) Height ($h$) of the trapezium

$$= \frac{2}{l}\sqrt{s(s-l)(s-c)(s-d)}$$

$$= \left(\frac{2A}{a+b}\right)$$

**Illustration 30:** Find the area of a trapezium having parallel sides 65 m and 44 m and distance between them being 20 m.

**Solution:** Area of the trapezium

$$= \frac{1}{2} \times (a + b) \times h$$

$$= \frac{1}{2} \times (65 + 44) \times 20$$

$$= 1100 \text{ cm}^2.$$

**Illustration 31:** The parallel sides of a trapezium are 24 m and 52 m. If its other two sides are 26 m and 30 m, then what is the area of the trapezium?

**Solution:** Area of the trapezium

$$= \frac{a+b}{l}\sqrt{s(s-l)(s-c)(s-d)}\,.$$

Here, $a = 24$, $b = 52$, $c = 26$, $d = 30$, $l = b - a = 28$,

$$s = \frac{c+d+l}{2} = \frac{26+30+28}{2} = 42.$$

$\therefore$ Area of the trapezium

$$= \frac{24+52}{28}\sqrt{42(42-28)(42-26)(42-30)}$$

$$= \frac{76}{28} \times \sqrt{42 \times 14 \times 16 \times 12}$$

$$= \frac{76 \times 336}{28} = 912 \text{ m}^2.$$

**Illustration 32:** The two parallel sides of a trapezium of area 180 cm$^2$ measure 28 cm and 12 cm. What is the height of the trapezium?

**Solution:** Height of the trapezium

$$= \left(\frac{2A}{a+b}\right) = \left(\frac{2 \times 180}{28+12}\right) = \frac{360}{40} = 9 \text{ cm}.$$

### 12. Walls of a Room

Area of four walls of a room

$= 2(\text{length} + \text{breadth}) \times \text{height}$

**Illustration 33:** Find the cost of painting the walls of a room of 6 m long, 5 m broad and 4 m high at ₹7.50 per m$^2$.

**Solution:** Area of 4 walls of the room

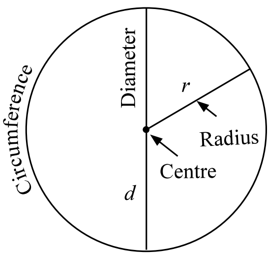
$= 2(\text{length} + \text{breadth}) \times \text{height}$

$= 2(6 + 5) \times 4 = 88 \text{ m}^2.$

$\therefore$ Cost of painting $= 88 \times 7.50 =$ ₹660.

### 12. Circle

A *circle* is the path travelled by a point which moves in such a way that its distance from a fixed point remains constant.




The fixed point is known as *centre* and the fixed distance is called the *radius*.

(a) Circumference or perimeter of a circle

$$= 2\pi r = \pi d,$$

where $r$ is radius and $d$ is diameter of the circle

(b) Area of a circle

$= \pi r^2$, $r$ is radius

$= \dfrac{\pi d^2}{4}$, $d$ is diameter

$= \dfrac{c^2}{4\pi}$, $c$ is circumference

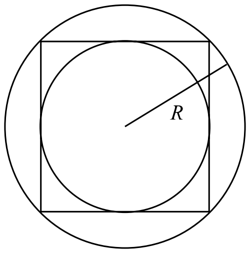
$= \dfrac{1}{2} \times \text{circumference} \times \text{radius}$

(c) Radius of a circle $= \sqrt{\dfrac{\text{Area}}{\pi}}$

$$= \frac{\text{Perimeter or circumference}}{2\pi}$$

(d) Ratio of the areas of the two circles is

$$= \frac{\text{Area of circle circumscribing the square}}{\text{Area of circle inscribed in the square}} = \frac{2}{1}.$$




(e) Ratio of the area of the two squares is

$$= \frac{\text{Area of square circumscribing the circle}}{\text{Area of square inscribed in the circle}} = \frac{2}{1}.$$

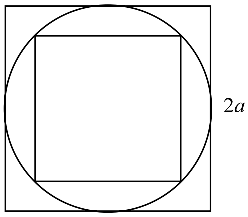



**Illustration 34:** What is the radius of a circular plot whose circumference is 176 m?

**Solution:** $r = \dfrac{\text{Circumference}}{2\pi}$

$$= \frac{176}{2\times\frac{22}{7}} = \frac{176\times 7}{2\times 22} = 28 \text{ m.}$$

**Illustration 35:** A circular plot covers an area of 154 m$^2$. How much wire is required for fencing the plot?

**Solution:** Area of the plot = $\pi r^2$ = 154

i.e., $r^2 = 154 \times \dfrac{7}{22} = 49$

$\therefore$ $r = 7$ m

$\therefore$ Length of the wire = $2\pi\, r = 2 \times \dfrac{22}{7}\times 7 = 44$ m.

**Illustration 36:** Find the length of a rope by which a buffalo must be tethered in order that she may be able to graze an area of 9856 m$^2$.

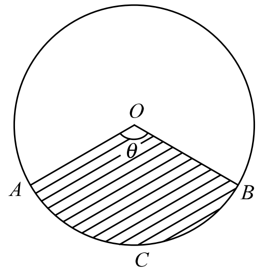
**Solution:** The required length of the rope

$$= r = \sqrt{\frac{\text{Area}}{\pi}}$$

$$= \sqrt{\frac{9856\times 7}{22}} = \sqrt{3136} = 56 \text{ m.}$$

## Sector

A *sector* is a figure enclosed by two radii and an arc lying between them.




For sector $AOB$,

Arc $AB = \dfrac{2\pi r\theta}{360}$,

where $r$ = radius and $\angle AOB = \theta$

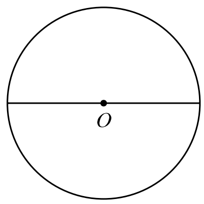
Area of the sector $ACBO$

$$= \frac{1}{2} \times (\text{arc } AB) \times \text{radius}$$

$$= \frac{\pi(\text{radius})^2\theta}{360}.$$

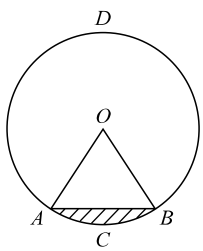
## Semi-Circle

A *semi-circle* is a figure enclosed by a diameter and the part of the circumference cut off by it.




## Segment

A *segment* of a circle is a figure enclosed by a chord and an arc which it cuts off.




***Note:***

Any chord of a circle which is not a diameter (such as AB), divides the circle into two segments, one is greater and the other is less than a semi-circle.

Area of segment $ACB$

= area of sector $ACBO$ – area of $\Delta OAB$

and area of segment $ADB$

= area of circle – area of segment $ACB$

**Illustration 37:** If a piece of wire 20 cm long is bent into an arc of a circle subtending an angle of 60° at the centre, find the radius of the circle.

**Solution:** Length of the arc = $\dfrac{2\pi r\theta}{360}$

$$\Rightarrow \quad 20 = \frac{2\pi r \times 60}{360} \Rightarrow r = \frac{20\times 360}{60\times 2\times \pi} = \frac{60}{\pi} \text{ cm.}$$

**Illustration 38:** Find the area of sector of a circle whose radius is 14 cm and the angle at the centre is 60°.

**Solution:** Area of thesector = $\dfrac{\pi(\text{radius})^2\theta}{360}$

$$= \frac{22\times 14\times 14\times 60}{7\times 360}$$

$$= \frac{22\times 2\times 14}{6} = 102\frac{2}{3} \text{ cm}^2.$$

**Illustration 39:** Find the area of sector of a circle whose radius is 10 cm and the length of the arc is 13 cm.

**Solution:** Area of the sector = $\dfrac{1}{2}\times$ (length of arc) × radius

$$= \frac{1}{2} \times 13 \times 10$$

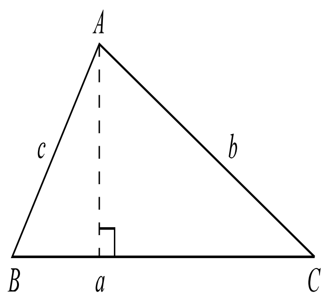
$$= 65 \text{ cm}^2.$$

### Polygon

A *polygon* is a plane figure enclosed by four or more straight lines.

### Regular Polygon

If all the sides of a polygon are equal, it is called a *regular polygon.*




All the interior angles of a regular polygon are equal.

For a regular polygon:

Sum of exterior angles = $2\pi$

Sum of interior angles = $(n - 2)\pi$

Number of diagonals in a polygon = $\dfrac{n(n-3)}{2}$

Perimeter ($P$) = $n \times a$,

where, $n$ = number of sides

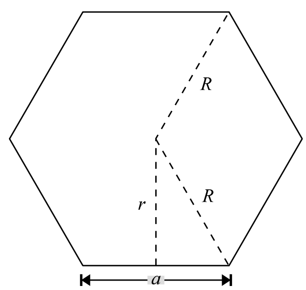
and, $a$ = length of each side

Each interior angle = $\dfrac{n-2}{n}\times\pi$

Each exterior angle = $\dfrac{2\pi}{n}$

Area = $\dfrac{1}{2} \times P \times r = \dfrac{1}{2} \times n \times a \times r$,

where, $r$ is radius of the circle drawn inside the polygon touching its sides.




$$= \frac{1}{2} \times n \times a \times \sqrt{R^2 - \left(\frac{a}{2}\right)^2},$$

where, $R$ is radius of the circle drawn outside the polygon touching its sides.

$$= \frac{na^2}{4}\cot\left(\frac{\pi}{n}\right).$$

Area of a regular hexagon = $\dfrac{3\sqrt{3}}{2}$ (side)$^2$

Area of a regular octagon = $2(\sqrt{2}+1)$ (side)$^2$.

**Illustration 40:** Find the side of a regular hexagon whose area is $48\sqrt{3}$ cm$^2$.

**Solution:** Area of a regular hexagon

$$= \frac{3\sqrt{3}}{2} \times (\text{side})^2$$

$$\Rightarrow \quad 48\sqrt{3} = \frac{3\sqrt{3}}{2} \times (\text{side})^2$$

$$\Rightarrow \quad (\text{side})^2 = 32$$

$\therefore$ Side of the hexagon = $4\sqrt{2}$ cm.

**Illustration 41:** Find the area of a regular octagon whose side measures $\sqrt{2}$ cm.

**Solution:** Area of regular octagon

$$= 2(\sqrt{2}+1)\times(\text{side})^2$$

$$= 2(\sqrt{2}+1)\times(\sqrt{2})^2$$

$$= 4(\sqrt{2}+1) \text{ cm}^2.$$

**Illustration 42:** Find the sum of interior angles of a regular polygon of 10 sides. Also, find the value of each interior angle.

**Solution:** Sum of interior angles = $(n - 2) \times \pi$

$= (10 - 2) \times \pi$

$= 8\pi$.

Also, value of each interior angle

$$= \left(\frac{n-2}{n}\right)\times\pi$$

$$= \left(\frac{10-2}{10}\right)\pi = \frac{4\pi}{5}.$$

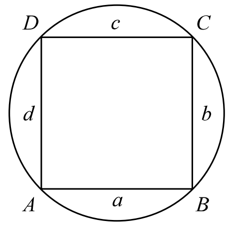
**Illustration 43:** Find the sum of all the exterior angles of a regular polygon of 12 sides. And, also find the value of each exterior angle.

**Solution:** Sum of exterior angles = $2\pi$

Also, value of each exterior angle = $\dfrac{2\pi}{n} = \dfrac{2\pi}{12} = \dfrac{\pi}{6}$.

### Cyclic Quadrilateral

A quadrilateral whose vertices lie on the circumference of the circle is called a *cyclic quadrilateral*.




For a cyclic quadrilateral

- Area = $\sqrt{s(s-a)(s-b)(s-c)(s-d)}$,

where,

$$s = \frac{a+b+c+d}{2}$$

- $\angle A + \angle B + \angle C + \angle D = 2\pi$
- $\angle A + \angle C = \angle B + \angle D = \pi$.

## SOME USEFUL SHORTCUT METHODS

1. If the length and the breadth of a rectangle are increased by $x$% and $y$% respectively, then the area of the rectangle will increase by $\left(x+y+\dfrac{xy}{100}\right)$%

**Explanation:**

Area of the original rectangle is

$$A = l \times b.$$

Area of the new rectangle is

$$A' = l\left(\frac{100+x}{100}\right)\times b\left(\frac{100+y}{100}\right)$$

$$= lb\left(\frac{100+x}{100}\right)\left(\frac{100+y}{100}\right)$$

$$= A\left(\frac{100+x}{100}\right)\left(\frac{100+y}{100}\right)$$

$$\therefore \quad \frac{A'}{A}-1=\left(\frac{100+x}{100}\right)\left(\frac{100+y}{100}\right) - 1$$

or, $$\frac{A'-A}{A} = \frac{(100+x)(100+y)-(100)^2}{(100)^2}$$

or, $$\left(\frac{A'-A}{A}\right)\times 100$$

$$= \frac{(100)^2 + 100(x+y)+xy-(100)^2}{(100)}$$

$\therefore$ Percentage increase in area = $\dfrac{100(x+y)+xy}{100}$ %

or, $\left(x+y+\dfrac{xy}{100}\right)$%

**Note:**

If any of $x$ or $y$ decreases, we put negative sign.

**Illustration 1:** The length and the breadth of a rectangle are increased by 20% and 5%, respectively. Find the percentage increase in its area.

**Solution:** Percentage increase in the area of rectangle

$$= \left(x + y + \frac{xy}{100}\right)\%$$

$$= \left(20 + 5 + \frac{20 \times 5}{100}\right)\% = 20\%$$

2. If the length of a rectangle is increased by $x$%, then its breadth will have to be decreased by $\left(\frac{100x}{100+x}\right)$% in order to maintain the same area of rectangle.

**Explanation:**

Percentage increase in area of rectangle

$$= \left(x + y + \frac{xy}{100}\right)\%$$

or, $$0 = \left(x + y + \frac{xy}{100}\right)$$

or, $$-x = y\left(1 + \frac{x}{100}\right) \quad \text{or,} \quad y = -\left(\frac{100x}{100+x}\right)$$

–ve sign indicates decrease.

Therefore, breadth must be decreased by $\left(\frac{100x}{100+x}\right)\%$ in order to maintain the same area.

**Illustration 2:** The length of a rectangle is increased by 25%. By what per cent should its breadth be decreased so as to maintain the same area?

**Solution:** The breadth must be decreased by

$$= \left(\frac{100x}{100+x}\right)\% = \left(\frac{100 \times 25}{100+25}\right)\%, \text{ i.e., } 20\%$$

3. If each of the defining dimensions or sides of any two-dimensional figure (triangle, rectangle, square, circle, quadrilateral, pentagon, hexagon, etc.) is changed by $x$%, its area changes by $x\left(2 + \frac{x}{100}\right)\%$

**Illustration 3:** If the radius of a circle is decreased by 10%, what is the percentage decrease in its area?

**Solution:** Here, $x = -10$ (–ve sign indicates decrease)

$\therefore$ Percentage change in area $= x\left(2 + \frac{x}{100}\right)\%$

$$= -10\left(2 - \frac{10}{100}\right)\%$$

$$= (-10)\left(\frac{19}{10}\right)\% = -19\%$$

$\therefore$ Area of the circle decreases by 19%

4. If all the sides of a quadrilateral are increased (or decreased) by $x$%, its diagonals also increase (or decrease) by $x$%

**Illustration 4:** The length and the two diagonals of a rectangle are decreased by 5% each. What is the percentage decrease in its breadth?

**Solution:** Since the length and the two diagonals decreased by 5% each, the breadth also must decrease by 5%.

5. If each of the defining dimensions or sides of any two-dimensional figures are increased (or decreased) by $x$%, its perimeter also increases (or decreases) by $x$%

**Illustration 5:** If all the sides and diagonals of a square are increased by 8% each, then find the percentage increase in its perimeter.

**Solution:** The perimeter also increases by 8%

6. If the ratio of the areas of two squares be $a$:$b$, then the ratio of their sides, ratio of their perimeters and the ratio of their diagonals, each will be in the ratio $\sqrt{a} : \sqrt{b}$.

**Illustration 6:** Ratio of the areas of two squares is 16:9. Find the ratio of their diagonals.

**Solution:** The ratio of their diagonals

$$= \sqrt{a} : \sqrt{b}$$

$$= \sqrt{16} : \sqrt{9}, \text{ i.e., } 4:3.$$

7. If the diagonal of a square increases by $x$ times, then the area of the square becomes $x^2$ times.

**Illustration 7:** The diagonal of a square is doubled. How many times will the area of the new square become?

**Solution:** The area of the new square will become $x^2$ times, i.e., $(2)^2 = 4$ times.

8. Standard Properties of Diagonals of Quadrilaterals

| *Quadrilateral* | *Meet at right angles* | *Bisect each other* | *Equal to each other* | *Bisect angle at vertex* |
|---|---|---|---|---|
| Square | √ | √ | √ | √ |
| Rectangle | × | √ | √ | × |
| Parallelogram | × | √ | × | × |
| Rhombus | √ | √ | × | √ |
| Trapezium | × | × | may or may not be | × |

9. Carpeting the Floor of a Room

If the length and the breadth of a room are $l$ and $b$, respectively, and a carpet of width $w$ is used to cover the floor, then the required length of the carpet

$$= \frac{l \times b}{w}.$$

**Illustration 8:** How many metres of a carpet of 12 cm wide will be required to cover the floor of a room which is 600 cm long and 420 cm broad? Also, calculate the amount required in carpeting the floor if the cost of carpet is ₹15 per metre.

**Solution:** Length of the carpet

$$= \frac{l \times b}{w}$$

$$= \frac{600 \times 420}{12}$$

$$= 21000 \text{ cm, i.e., } 210 \text{ m.}$$

The amount required for carpeting the floor

$$= 15 \times 210 = ₹3150.$$

10. Number of Square Tiles Required for Flooring

If the length and the breadth of a room are $l$ and $b$ respectively, then the least number of square tiles required to cover the floor

$$= \frac{l \times b}{\text{H.C.F. } (l, b)}$$

Also, the size of the largest tile so that the tiles exactly fit = H.C.F. $(l, b)$.

**Illustration 9:** A hall of length 24 cm and breadth 20 m is to be paved with equal square tiles. What will be the size of the largest tile so that the tiles exactly fit and also find the number of tiles required.

**Solution:** Size of the largest possible square tile

$$= \text{H.C.F. } (l, b)$$

$$= \text{H.C.F. } (24, 20) = 4 \text{ m}$$

Number of tiles required

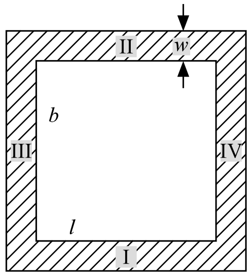
$$= \frac{l \times b}{\text{H.C.F. } (l, b)}$$

$$= \frac{24 \times 20}{4} = 120 \text{ tiles.}$$

11. Path around a Rectangular Space

(a) A rectangular garden $l$ m long and $b$ m broad is sorrounded by a path of $w$ m wide. The area of the path is given by

$$= 2w(l + b + 2w) \text{ m}^2.$$




**Explanation:**

Area of part I = Area of part II

$$= (l + 2w)w \text{ m}^2$$

Area of part III = Area of part IV

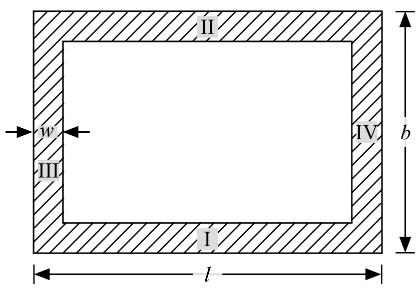
$$= bw \text{ m}^2.$$

$\therefore$ Total area of the path $= 2[(l + 2w)w + bw]$

$$= 2w(l + b + 2w) \text{ m}^2.$$

(b) A rectangular garden $l$ m long and $b$ m broad is sorrounded by a path of $w$ m wide constructed inside it along its boundary. The area of the path is given by

$$= 2w(l + b - 2w) \text{ m}^2.$$



**Explanation:**

Area of part I = Area of part II

$= lw$ m$^2$

Area of part III = Area of part IV

$= (b - 2w)w$ m$^2$

$\therefore$ Total area of the path

$= 2[lw + (b - 2w)w]$

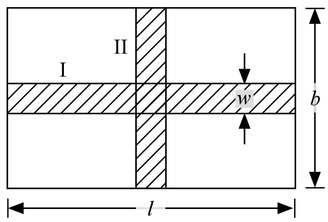
$= 2w(l + b - 2w)$ m$^2$.

(c) A rectangular park is $l$ m long and $b$ m broad. Two paths inside the park of $w$ m wide and they are perpendicular to each other. The area of the paths

$= w(l + b - w)$ m$^2$

Also, the area of the park minus the paths

$= (l - w)(b - w)$ m$^2$




**Explanation:**

Total area of the path

= Area of path I + Area of path II − Area of common central part

$= lw + bw - w^2$

$= w(l + b - w)$ m$^2$.

$\therefore$ Area of the park minus the paths

$= [lb - w(l + b - w)]$

$= lb - lw - w(b - w)$

$= l(b - w) - w(b - w)$

$= (l - w)(b - w)$ m$^2$.

*Notes:*

1. Clearly, from the figure, the area of the paths does not change on shifting their location as long as they are perpendicular to each other.
2. For a square park, take $l = b$ in all the results derived above.

**Illustration 10:** A rectangular park 18 m × 12 m, is sorrounded by a path of 4 m wide. Find the area of the path.

**Solution:** The area of the path

$= 2w(l + b + 2w)$

$= 2 \times 4(18 + 12 + 2 \times 4) = 304$ m$^2$.

**Illustration 11:** A park is square in shape with side 18 m. Find the area of the pavement of 3 m wide to be laid all around it on its inside.

**Solution:** Area of the pavement

$= 2w(l + b - 2w)$

$= 2 \times 3(18 + 18 - 2 \times 3)$ (Here, $l = b = 18$)

$= 180$ m$^2$.

**Illustration 12:** A playground measures 27 m × 13 m. From the centre of each side a path 2 m wide goes across to the centre of the opposite side. Calculate the area of the path and the cost of constructing it at ₹4 per m$^2$.

**Solution:** Area of the path

$= w(l + b - w) = 2(27 + 13 - 2)$

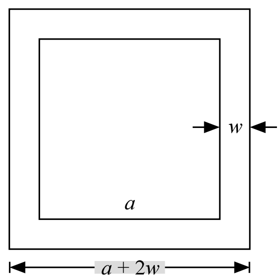
$= 76$ m$^2$.

$\therefore$ Cost $= 4 \times 76 =$ ₹304.

12. Square Room Surrounded by a Verandah

(a) A square room of side $a$ is sorrounded by a verandah of width $w$ on the outside of the square room. If the area of the verandah is $A$, then the area of the room is given by

$$\left(\frac{A-4w^2}{4w}\right)^2.$$




**Explanation:**

Area of the room $= a^2$.

Area of the (room + verandah) $= (a + 2w)^2$.

$\therefore$ Area ($A$) of the verandah $= (a + 2w)^2 - a^2$

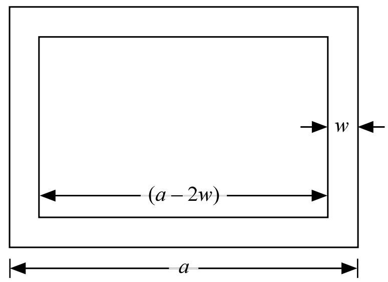
$= (4aw + 4w^2)$

or, $a = \dfrac{A-4w^2}{4w}$

$\therefore$ Area of the room $= a^2 = \left(\dfrac{A-4w^2}{4w}\right)^2$.

(b) A square room of side $a$ is surrounded by a verandah of width $w$ on its inside. If the area of the verandah is A, then the area of the room is given by

$$\left(\frac{A+4w^2}{4w}\right)^2.$$




**Explanation:**

Area ($A$) of the verandah $= a^2 - (a - 2w)^2$

$= 4aw - 4w^2$

$= 4w(a - w)$

or, $a = \frac{A}{4\omega} + w = \frac{A+4w^2}{4w}$

$\therefore$ Area of the room $= a^2 = \left(\frac{A+4w^2}{4w}\right)^2$.

**Illustration 13:** A square field is surrounded by a path of 2 m wide on its outside. The area of the path is 72 m$^2$. What is the area of the field?

**Solution:** Area of the field

$$= \left(\frac{A-4w^2}{4w}\right)^2$$

$$= \left(\frac{72-4\times 2^2}{4\times 2}\right)^2 = 49 \text{ m}^2.$$

**Illustration 14:** A square room has a verandah of area 24 m$^2$ and width 1 m all around it on its inside. Find the area of the room.

**Solution:** Area of the room

$$= \left(\frac{A+4w^2}{4w}\right)^2$$

$$= \left(\frac{24\times 4\times 1^2}{4\times 1}\right)^2 = 49 \text{ m}^2.$$

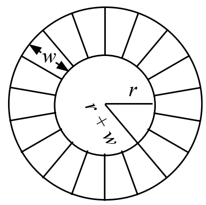
13. (a) A circular ground of radius $r$ has a pathway of width $w$ around it on its outside. The area of the circular pathway is given by $= \pi w(2r + w)$.

**Explanation:**

Area of the circular ground $= \pi r^2$

Area of the circular ground + pathway

$= \pi(r + w)^2 = \pi r^2 + 2\pi\, rw + \pi w^2$.




$\therefore$ Area of circular the pathway

$= (\pi r^2 + 2\pi\, rw + \pi w^2) - \pi r^2$

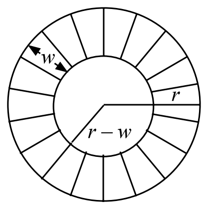
$= \pi w(2r + w)$.

(b) A circular ground of radius $r$ has a pathway of width $w$ around it on its inside. The area of the circular pathway is given by

$= \pi w(2r - w)$.

**Explanation:**

Area of circular the ground $= \pi r^2$




Area of the circular ground − pathway

$= \pi\,(r - w)^2$

$= \pi r^2 - 2\pi\, rw + \pi w^2$

$\therefore$ Area of the circular pathway

$= \pi r^2 - (\pi r^2 - 2\pi rw + \pi w^2)$

$= \pi w(2r - w)$.

**Illustration 15:** A circular ground of radius 16 m has a path of width 2.8 m around it on its outside. Find the area of the path.

**Solution:** The area of the circular path

$= \pi\, w(2r + w)$

$= \frac{22}{7} \times 2.8 \times (2 \times 16 + 2.8)$

$= 8.8 \times (32 + 2.8) = 306.2$ m$^2$.

**Illustration 16:** A circular park of radius 22 m has a path of width 1.4 m around it on its inside. Find the area of the path.

**Solution:** The area of the circular path

$$= \pi\, w(2r - w)$$

$$= \frac{22}{7} \times 1.4 \times (2 \times 22 - 1.4)$$

$$= 4.4 \times (44 - 1.4) = 187.45 \text{ m}^2.$$

> 14. If the area of a square is $a$ cm$^2$, then the area of the circle formed by the same perimeter is $\left(\frac{4a}{\pi}\right)$ cm$^2$.

**Explanation:**

Area of the square = $a$.

$\therefore$ Side of the square = $\sqrt{\text{Area}} = \sqrt{a}$ .

$\therefore$ Perimeter of the square = $4\sqrt{a}$ .

Given, Circumference of the circle = Perimeter of the square

$\Rightarrow$ $2\pi\, r = 4\sqrt{a}$

$\therefore$ Radius of the circle ($r$) = $\dfrac{4\sqrt{a}}{2\pi} = \dfrac{2\sqrt{a}}{\pi}$

$\therefore$ Area of the circle = $\pi r^2 = \pi\left(\dfrac{2\sqrt{a}}{\pi}\right)^2 = \dfrac{4a}{\pi}$ cm$^2$.

**Illustration 17:** If the area of a square is 33 cm$^2$, then find the area of the circle formed by the same perimeter.

**Solution:** Required area of the circle

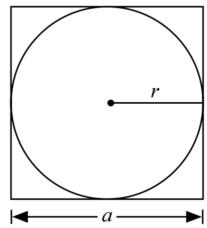
$$= \frac{4a}{\pi}$$

$$= \frac{4\times 33}{\pi} = \frac{4\times 33\times 7}{22} = 42 \text{ cm}^2.$$

> 15. The area of the largest circle that can be inscribed in a square of side $a$ is $\dfrac{\pi a^2}{4}$.

**Explanation**

Clearly, from the figure, the diameter of the inscribed circle equals the side of the square i.e., $D = a$.




Area of the circle = $\dfrac{\pi D^2}{4}$

$\therefore$ Area of the inscribed circle = $\dfrac{\pi a^2}{4}$.

**Illustration 18:** Find the area of largest circle inscribed in a square of side 112 cm.

**Solution:** The area of the largest circle

$$= \frac{\pi a^2}{4}$$

$$= \frac{22\times 112\times 112}{7\times 4} = 9856 \text{ cm}^2.$$

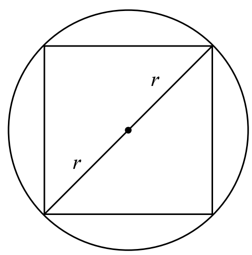
> 16. Area of a square inscribed in a circle of radius $r$ is $2r^2$ and the side of the square is $\sqrt{2}\,r$.

**Explanation:**

Clearly, from the figure, diagonal of the inscribed square is equal to the diameter of the circle, i.e., $2r$.

$\therefore$ Area of square = (diagonal)$^2$

$$= \frac{1}{2}\,(2r)^2 = 2r^2.$$




Also, side of the square = $\sqrt{\text{Area}} = \sqrt{2r^2} = \sqrt{2}r$.

**Illustration 19:** Find the side of the square inscribed in a circle whose circumference is 308 cm.

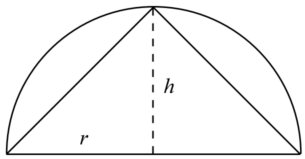
**Solution:** Circumference of the circle ($2\pi r$) = 308

$$\Rightarrow \quad r = \frac{308}{2\pi} = \frac{308 \times 7}{2 \times 22} = 49 \text{ cm.}$$

$\therefore$ Side of the inscribed square = $\sqrt{2}\, r = 49\sqrt{2}$ cm.

17. The area of the largest triangle inscribed in a semi-circle of radius $r$ is $r^2$.

**Explanation:**
Clearly, from the figure, the largest triangle inscribed in a semi-circle is an isosceles triangle with diameter as its base and radius as its height.




$$\text{Area of the triangle} = \frac{1}{2} \times \text{base} \times \text{height}$$
$$= \frac{1}{2} \times 2r \times r = r^2.$$

18. The number of revolutions made by a circular wheel of radius $r$ in travelling a distance $d$ is given by

$$= \left(\frac{d}{2\pi r}\right).$$

**Explanation:**
Circumference of the wheel = $2\pi r$

In travelling a distance $2\pi r$, the wheel makes 1 revolution.

$\therefore$ In travelling a distance $d$, the wheel makes $\frac{22}{7}$ revolutions.

**Illustration 20:** The diameter of a wheel is 2 cm. If it rolls forward covering 10 revolutions, find the distance travelled by it.

**Solution:** Radius of the wheel = 1 cm.

The distance travelled by the wheel in 10 revolutions

$$= 10 \times 2\pi r$$
$$= 10 \times 2 \times \frac{22}{7} \times 1 = 62.8 \text{ cm.}$$

## EXERCISE-I

**1.** The area of a triangle whose sides are 15 m, 16 m and 17 m is:

(a) $24\sqrt{4}$ m$^2$ (b) $24\sqrt{3}$ m$^2$
(c) $24\sqrt{21}$ m$^2$ (d) None of these

**2.** The area of a right-angled triangle with base 6 m and hypotenuse 6.5 m is:

(a) 7.5 m$^2$ (b) 9.5 m$^2$
(c) 8.5 m$^2$ (d) None of these

**3.** The length of each side of a triangle is 12 cm. The height of the triangle is:

(a) $3\sqrt{2}$ m (b) $6\sqrt{3}$ m
(c) $6\sqrt{2}$ (d) None of these

**4.** The area of a triangular lawn is 1600 m$^2$. If one side is 64 m long and the other two sides are equal in length, the length of each equal side is:

(a) 60.37 m (b) 59.36 m
(c) 60.36 cm (d) None of these

**5.** Three sides of a triangular field are 20 m, 21 m and 29 m long, respectively. The area of the field is:

(a) 215 m$^2$ (b) 230 m$^2$
(c) 210 m$^2$ (d) None of these

**6.** The hypotenuse and the semi-perimeter of a right triangle are 20 cm and 24 cm, respectively. The other two sides of the triangle are:

(a) 16 cm, 12 cm
(b) 20 cm, 12 cm
(c) 20 cm, 16 cm
(d) None of these

**7.** The sides of a triangle are in the ratio 3:4:5. If its perimeter is 36 cm, then the area of the triangle is:

(a) 57 m$^2$ (b) 54 m$^2$
(c) 56.5 m$^2$ (d) None of these

**8.** For a triangle whose sides are 50 m, 78 m and 112 m, respectively, then the length of the perpendicular from the opposite angle on the side 112 m is:

(a) 45 m (b) 35 m
(c) 30 m (d) None of these

**9.** A ladder is resting with one end in contact with the top of a wall of height 12 m and the other end on the ground is at a distance 5 m from the wall. The length of the ladder is:

(a) 13 m (b) 17 m
(c) 16 m (d) None of these

**10.** A ladder is placed so as to reach a window 63 cm high. The ladder is then turned over to the opposite side of the street and is found to reach a point 56 cm high. If the ladder is 65 cm long, then the width of the street is:

(a) 59 cm (b) 39 cm
(c) 49 cm (d) None of these

**11.** If the area of a triangle with base $x$ is equal to the area of a square with side $x$, then the altitude of the triangle is:

(a) $\frac{x}{2}$ (b) $x$
(c) $2x$ (d) $3x$

**12.** If the area of a triangle is 150 $m^2$ and the ratio of the base and the height is 3:4, then find its height.

(a) 25 m (b) 35 m
(c) 20 m (d) None of these

**13.** The base of a triangular field is three times its height. If the cost of cultivating the field at ₹36.72 per hectare is ₹495.72, then find its base and height.

(a) 950 m, 350 m (b) 800 m, 500 m
(c) 900 m, 300 m (d) None of these

**14.** If the sides of a triangle are doubled, its area:

(a) remains same (b) is doubled
(c) becomes 4 times (d) Can't say

**15.** Two sides of a triangular field are 85 m and 154 m, respectively, and its perimeter is 324 m. The cost of ploughing the field at the rate of ₹10 per $m^2$ is:

(a) ₹27720 (b) ₹37620
(c) ₹26750 (d) None of these

**16.** The area of an equilateral triangle, each of whose sides measures $2\sqrt{3}$ cm is:

(a) $5\sqrt{3}$ $m^2$ (b) $4\sqrt{3}$ $m^2$
(c) $3\sqrt{3}$ $cm^2$ (d) None of these

**17.** If the height of an equilateral triangle is $2\sqrt{3}$ cm, then the length of its side is:

(a) 4 cm (b) 6 cm
(c) 5 cm (d) None of these

**18.** If the perimeter of an equilateral triangle is 12 m, then find its area.

(a) $3\sqrt{4}$ m (b) $4\sqrt{3}$ m
(c) $5\sqrt{3}$ m (d) None of these

**19.** The height of an equilateral triangle whose perimeter is 24 cm, is:

(a) $4\sqrt{3}$ cm (b) $3\sqrt{4}$ cm
(c) $5\sqrt{3}$ cm (d) None of these

**20.** The perimeter of a right angled triangle is 90 cm and its hypotenuse is 39 cm. Find its other sides.

(a) 30 cm, 10 cm (b) 36 cm, 15 cm
(c) 48 cm, 20 cm (d) None of these

**21.** The perimeter of an isosceles triangle is 306 m and each of the equal sides is $\frac{5}{8}$ of the base. Find the area.

(a) 3648 cm (b) 3468 $m^2$
(c) 3846 cm (d) None of these

**22.** Find the area of an isosceles right-angled triangle whose hypotenuse is 8 cm.

(a) 32 $m^2$ (b) 24 $cm^2$
(c) 16 $cm^2$ (d) None of these

**23.** The perimeter of an isosceles triangle is equal to 14 cm; the lateral side and the base is in the ratio 5:4. The area of the triangle is:

(a) $3\sqrt{21}$ $cm^2$ (b) $2\sqrt{21}$ $cm^2$
(c) $4\sqrt{21}$ $cm^2$ (d) None of these

**24.** If all the sides of a triangle are increased by 200%, then the area of the triangle will increase by:

(a) 400% (b) 600%
(c) 800% (d) None of these

**25.** A plot of land is in the shape of a right-angled isosceles triangle. The length of the hypotenuse is $50\sqrt{2}$ m. The cost of fencing is ₹3 per metre. The total cost of fencing the plot will be:

(a) Less than ₹300
(b) Less than ₹500
(c) More than ₹500
(d) None of these

**26.** If the area of an equilateral triangle is equal to the area of an isosceles triangle whose base and equal sides are 16 cm and 10 cm respectively, then the side of the equilateral triangle is:

(a) 10.5 cm (b) 9.5 cm
(c) 12.5 cm (d) None of these

**27.** If the perimeter of a right-angled isosceles triangle is $4\sqrt{2} + 4$ m, then the hypotenuse is:

(a) 8 m (b) 6 m
(c) 4 m (d) None of these

**28.** The two adjacent sides of a parallelogram are 60 m and 40 m and one of the diagonals is 80 m long. The area of the parallelogram is:

(a) $600\sqrt{15}$ $m^2$ (b) $800\sqrt{25}$ $m^2$
(c) $700\sqrt{15}$ $m^2$ (d) None of these

**29.** One side of the parallelogram is 14 cm. Its distance from the opposite side is 16 cm. The area of the parallelogram is:

(a) 234 $cm^2$ (b) 324 $cm^2$
(c) 224 $cm^2$ (d) None of these

**30.** A field is in the shape of a parallelogram. Its adjacent sides and one diagonal are 65 m, 119 m and 156 m, respectively. Find the cost of gravelling it at the rate of ₹10 per $m^2$.

(a) ₹81400 (b) ₹71400
(c) ₹91400 (d) None of these

**31.** One side of a parallelogram is 10 m and the corresponding altitude is 7 m. The area of the parallelogram is:

(a) 70 $m^2$ (b) 60 $m^2$
(c) 80 $m^2$ (d) None of these

**32.** The adjacent sides of a parallelogram are 8 m and 5 m. The distance between the longer sides is 4 m. The distance between the shorter sides is:

(a) 4.6 m (b) 6.4 m
(c) 8.6 m (d) None of these

**33.** The area of a quadrilateral is 420 $m^2$ and the perpendiculars drawn to one diagonal from the opposite vertices are 18 m and 12 m. Then, the length of the diagonal is:

(a) 32 m (b) 24 m
(c) 28 m (d) None of these

**34.** The area of a parallelogram is 72 $cm^2$ and its altitude is twice the corresponding base. The length of the base is:

(a) 6 cm (b) 8 cm
(c) 4 cm (d) None of these

**35.** The area of a parallelogram is 240 $cm^2$ and its height is 12 cm. The base of the parallelogram is:

(a) 24 cm (b) 20 cm
(c) 28 cm (d) None of these

**36.** In a quadrilateral $ABCD$, the sides, $AB$, $BC$, $CD$, $DA$ measure 20 m, 13 m, 17 m and 10 m, respectively and the diagonal $AC$ is 21 m. The area of the quadrilateral is:

(a) 210 $m^2$ (b) 220 $m^2$
(c) 240 $m^2$ (d) None of these

**37.** If the two diagonals of a parallelogram are 72 cm and 30 cm respectively, then find its perimeter.

(a) 156 cm (b) 164 cm
(c) 172 cm (d) None of these

**38.** If the base of a parallelogram is $(x + 4)$, altitude to the base is $(x - 3)$ and the area is $(x^2 - 4)$, then the actual area is equal to:

(a) 64 sq units (b) 48 sq units
(c) 60 sq units (d) None of these

**39.** In a parallelogram, the lengths of adjacent sides are 12 cm and 14 cm, respectively. If the length of one diagonal is 16 cm, then find the length of the other diagonal.

(a) 24.8 cm (b) 20.6 cm
(c) 22.4 cm (d) None of these

**40.** Find the perimeter of a circular plot which occupies an area of 154 $m^2$.

(a) 54 m (b) 44 m
(c) 22 m (d) 11 m

**41.** The perimeter of a circle is equal to that of a square. Compare their areas.

(a) 14:11 (b) 25:12
(c) 24:7 (d) 22:7

**42.** The length of a rectangle is thrice its breadth and its perimeter is 96 m. The area of the rectangle is:

(a) 288 $m^2$ (b) 442 $m^2$
(c) 438 $m^2$ (d) 432 $m^2$

**43.** A cow is tied by a rope at the corner of a rectangular field. If the length of the rope is 14 m, then the area of the field which the cow could graze is:

(a) 77 $m^2$ (b) 308 $m^2$
(c) 23 $m^2$ (d) 154 $m^2$

**44.** The wheel of a scooter has diameter 70 cm. How many revolutions per minute must the wheel make so that the speed of the scooter is kept 66 Km/h?

(a) 400 (b) 600
(c) 500 (d) 800

**45.** 2 small circular parks of diameters 16 m, 12 m are to be replaced by a bigger circular park. What would be the radius of this new park, if the new park occupies same space as the two small parks?

(a) 10 (b) 15
(c) 20 (d) 25

**46.** A rectangular park is 65 m long and 50 m wide. 2 cross paths each 2 m wide are to be constructed parallel to the sides. If these paths pass through the centre of the rectangle and cost of construction is ₹17.25 per $m^2$, then find the total cost involved in the construction.

(a) ₹2265.59 (b) ₹1772.45
(c) ₹3898.50 (d) ₹8452.32

**47.** The area of a trapezium is 2500 $m^2$. One of its parallel sides is 75 m. If the distance between the two parallel sides is 40 m, then find the length of the other parallel side.

(a) 20 m (b) 30 m
(c) 40 m (d) 50 m

**48.** The length of a rectangle exceeds its breadth by 3 cm. If the numerical values of the area and the perimeter of the rectangle are equal, then the breadth is:

(a) 1 cm (b) 2 cm
(c) 3 cm (d) 3.5 cm

**49.** If the ratio of the areas of two squares is 9:1, then the ratio of their perimeters is:

(a) 9:1 (b) 3:4
(c) 3:1 (d) 1:3

**50.** A square field with side 30 m is surrounded by a path of uniform width. If the area of the path is 256 $m^2$, then its width is:

(a) 16 m (b) 14 m
(c) 4 m (d) 2 m

**51.** A rope by which a calf is tied is increased from 12 m to 23 m. How much additional grassy ground shall it graze?

(a) 1120 $m^2$ (b) 1250 $m^2$
(c) 1210 $m^2$ (d) 1200 $m^2$

**52.** Four circular cardboard pieces, each of radius 7 cm are placed in such a way that each piece touches two other pieces. The area of the space enclosed by the four pieces is:

(a) 21 $cm^2$ (b) 42 $cm^2$
(c) 84 $cm^2$ (d) 168 $cm^2$

**53.** The length and breadth of a rectangular field are in the ratio 5:3. If the cost of cultivating the field at 25 paise per square metre is ₹6000, then find the dimensions of the field:

(a) 250 m, 100 m (b) 50 m 30 m
(c) 200 m, 120 m (d) Cannot be determined

**54.** The cost of carpeting a room 5 m wide with carpet at ₹3.50 per $m^2$ is ₹105. The length of the room is:

(a) 3.5 m (b) 5 m
(c) 6 m (d) 6.5 m

**55.** The length of a rectangular field is twice its breadth. If the rent of the field at ₹3500 per hectare is ₹28000, then find the cost of surrounding it with fence at ₹5 per metre.

(a) ₹6000 (b) ₹7000
(c) ₹6500 (d) ₹8000

**56.** The area of a rectangular field is 27000 $m^2$. The ratio of its length and breadth is 6:5. The length and breadth of the field are respectively:

(a) 180 m, 150 m
(b) 200 m, 150 m
(c) 180 m, 120 m
(d) 150 m, 100 m

**57.** The area of a sector of a circle of radius 5 cm, formed by an arc of length 3.5 cms, is:

(a) 35 $cm^2$ (b) 17.5 $cm^2$
(c) 8.75 $cm^2$ (d) 55 $cm^2$

**58.** The length of a plot is double its width. If a square piece of land of area 150 $m^2$ occupies $\frac{1}{3}$ area of the plot, then what is the length of the plot?

(a) 15 m (b) 7.5 m
(c) 30 m (d) 10 m

**59.** A wire is in the form of a semi-circle of 7 cm radius. The length of the wire will be:

(a) 25 cm (b) 36 cm
(c) 5 cm (d) 69 cm

**60.** A circular road runs round a circular ground. If the difference between the circumferences of the outer circle and the inner circle is 66 m, the width of the road is:

(a) 21 m (b) 10.5 m
(c) 7 m (d) 5.25 m

**61.** If the area of a square is 50 sq units, then the area of the circle drawn on its diagonal is:

(a) 25 $\pi$ sq units (b) 50 $\pi$ sq units
(c) 100 $\pi$ sq units (d) None of these

**62.** A rectangular sheet of cardboard is of 4 cm × 2 cm. If a circle of greatest possible area is cut from it, then the area of remaining portion is:

(a) $(2 - \pi)$ $cm^2$ (b) $(4 - \pi)$ $cm^2$
(c) $(8 - \pi)$ $cm^2$ (d) $(16 - \pi)$ $cm^2$

**63.** What is the radius of a circle, to the nearest cm, whose area is equal to the sum of the areas of the three circles of radii 22 cm, 19 cm and 8 cm, respectively?

(a) 17 cm (b) 30 cm
(c) 29 cm (d) 19 cm

**64.** The length of a rectangle is increased by 33.33%. By what per cent should the width be decreased to maintain the same area?

(a) 25% (b) 33.33%
(c) 22.5% (d) None of these

**65.** If the area of a square is equal to the area of a rectangle 6.4 m long and 2.5 m wide, then each side of the square measures:

(a) 8 m (b) 5.4 m
(c) 3.8 m (d) 4 m

**66.** The diameters of two concentric circles are 8 cm and 10 cm. The area of the region between them is:

(a) $\pi$ cm$^2$ (b) $3\pi$ cm$^2$
(c) $6\pi$ cm$^2$ (d) $9\pi$ cm$^2$

**67.** The length of a rectangular room is 4 m. If it can be partitioned into two equal square rooms, what is the length of the partition in metres?

(a) 1 (b) 2
(c) 4 (d) Data inadequate

**68.** A rectangular carpet has an area of 120 m$^2$ and a perimeter of 46 m. The length of its diagonal is:

(a) 15 m (b) 16 m
(c) 17 m (d) 20 m

**69.** The side of a square is 22 m. What is the radius of the circle whose circumference is equal to the perimeter of the square?

(a) 28 m (b) 3.5 m
(c) 14 m (d) 7 m

**70.** A piece of wire 132 cm long is bent successively in the shapes of an equilateral triangle, a square, a regular hexagon, and a circle. Then, which has the largest surface area?

(a) Equilateral triangle
(b) Square
(c) Circle
(d) Regular hexagon

**71.** If the radius of one circle is twelve times the radius of another, how many times does the area of the greater contain the area of the smaller?

(a) 12 (b) 72
(c) 144 (d) 96

**72.** If the circumference of a circle is equal to the perimeter of a square, what is the ratio of the area of the circle to the area of the square?

(a) 22:7 (b) 14:11
(c) 11:7 (d) 4:1

**73.** The length of a rectangular plot of land is three times as much as its breadth. A playground measuring 1200 ft$^2$ occupies $\frac{1}{4}$ of the total area of the plot. What is the length of the plot in feet?

(a) 40 (b) 360
(c) 120 (d) Data inadequate

**74.** There are two squares $s_1$ and $s_2$. The ratio of their areas is 4:25. If the side of $s_1$ is 6 cm, what is the side of $s_2$?

(a) 20 cm (b) 15 cm
(c) 5 cm (d) 12 cm

**75.** The radius of the wheel of a vehicle is 70 cm. The wheel makes 10 revolutions in 5 seconds. The speed of the vehicle is:

(a) 29.46 Km/h (b) 31.68 Km/h
(c) 36.25 Km/h (d) 32.72 Km/h

**76.** A rectangular carpet has an area of 60 m$^2$. Its diagonal and longer side together equal 5 times the shorter side. The length of the carpet is:

(a) 5 m (b) 13 m
(c) 14.5 m (d) 12 m

**77.** A playground has the shape of a rectangle with two semi-circles on its smaller sides as diameters, added outside. If the sides of the rectangle are 36 m and 24.5 m, then the area of the playground is: $\left(\text{use } \pi = \frac{22}{7}\right)$

(a) 2259.529 m$^2$ (b) 1353.625 m$^2$
(c) 1139.523 m$^2$ (d) None of these

**78.** A man runs around a circle of 50 m radius at a speed of 12 Km/h. Find the time taken by him for going around it ten times:

(a) 10 minutes (b) 12.5 minutes
(c) 15.7 minutes (d) None of these

**79.** A room 5 m $\times$ 8 m is to be carpeted leaving a margin of 10 cm from each wall. If the cost of the carpet is ₹18 per m$^2$, then the cost of carpeting the room will be:

(a) ₹702.60 (b) ₹691.80
(c) ₹682.46 (d) ₹673.92

**80.** The area of a big rectangle is equal to the area of a small rectangle. If the length of the big rectangle is equal to the length of the small rectangle and the width of big rectangle is 2 m, what is the width of a small rectangle?

(a) $\frac{1}{3}$ m (b) 1 m
(c) 2 m (d) Cannot be determined
(e) None of these

**81.** If the radius of a circle is reduced by 40%, then its circumference is reduced by:

(a) 60% (b) 40%
(c) 35% (d) 45%

**82.** A figure consists of a square of side '$a$' m with semi-circles drawn on the outside of the square. The area (in $m^2$) of the figure so formed will be:

(a) $a^2$ (b) $a^2 + 2\pi a^2$

(c) $4\pi a^2$ (d) $a^2 + \dfrac{\pi a^2}{2}$

**83.** The area of a square field is 6050 $m^2$. How much time it will take to reach from one of its corner to the opposite corner at the rate of 10 m in every 30 seconds?

(a) $5\frac{1}{2}$ minutes (b) 11 minutes

(c) 22 minutes (d) 110 minutes

**84.** If a regular hexagon is inscribed in a circle of radius $r$, then its perimeter is:

(a) $3r$ (b) $6r$

(c) $9r$ (d) $12r$

**85.** 2 poles 15 m and 30 m high stand upright in a playground. If their feet be 36 m apart, find the distance between their tops.

(a) 36 m (b) 39 m

(c) 15 m (d) None of these

**86.** The length of a rectangular hall is $\frac{4}{3}$ of its width. If the area of the hall is 300 $m^2$, what is the difference between the length and the breadth?

(a) 15 m (b) 20 m

(c) 3 m (d) 5 m

(e) 6 m

**87.** Each side of an equilateral triangle is increased by 1.5%. The percentage increase in its area is:

(a) 1.5% (b) 3%

(c) 4.5% (d) 5.7%

**88.** A rope, by which a horse is tied, is increased from 12 to 23 m. How much additional ground will it be able to graze?

(a) 1315 $m^2$ (b) 765 $m^2$

(c) 1210 $m^2$ (d) 1012 $m^2$

**89.** If a diagonal of a square is doubled, how does the area of the square change?

(a) Becomes 4-fold

(b) Becomes 3-fold

(c) Becomes 2-fold

(d) None of these

**90.** If the sides of a rectangle are increased by 20%, the percentage increase in its perimeter is:

(a) 80 (b) 40

(c) 20 (d) None of these

**91.** A circle road runs around a circular garden. If the difference between the circumference of the outer circle and the inner circle is 44 m, then find the width of the road.

(a) 4 m (b) 7 m

(c) 3.5 m (d) 7.5 m

**92.** The length of a rectangular field is double its width. Inside the field there is a square-shaped pond 8 m long. If the area of the pond is $\frac{1}{8}$ of the area of the field, what is the length of the field?

(a) 32 m (b) 64 m

(c) 16 m (d) 20 m

(e) None of these

**93.** A circular disc of area $0.49\pi$ $m^2$ rolls down a length of 1.76 Km. The number of revolutions it makes is:

(a) 300 (b) 400

(c) 600 (d) 4000

**94.** If area of a triangle whose base is 6 cm is equal to the area of a circle of radius 6 cm, then find the height of this triangle:

(a) 10 cm (b) 22 cm

(c) 12 cm (d) 18 cm

**95.** The length of a ladder exactly equals the height of a wall. If the ladder is placed on a 2-feet tall stool placed 10 feet away from the wall, its tip just touches the top of the wall. The height of the wall in feet is:

(a) 15 (b) 26

(c) 28 (d) 32

**96.** If the diagonal of a square is doubled to make another square, the area of the new square will:

(a) Become 4-fold

(b) Become 2-fold

(c) Become 6-fold

(d) Become 8-fold

**97.** The area of a circle is 154 $cm^2$. The length of an arc of the circle which subtends an angle of 45° at the centre is:

(a) 11 cm (b) 5.5 cm

(c) 7 cm (d) None of these

**98.** A lawn is in the form of a triangle having its base and height in the ratio 2:3. The area of the lawn is $\frac{1}{12}$ hectare. Find the base and height of the lawn.

(a) 55 m, 34 m (b) 50 m, $33\frac{1}{3}$ m

(c) 50 m, 35 m (d) Data inadequate

**99.** A rectangular farm has to be fenced on one long side, one short side and the diagonal. If the cost of fencing is ₹10 per m, the area of the farm is 1200 $m^2$ and the short side is 30 m long, how much would the job cost?

(a) ₹700 (b) ₹1200
(c) ₹1400 (d) ₹1500

**100.** The diameter of a circle is 105 cm less than the circumference. What is the diameter of circle?

(a) 44 cm (b) 46 cm
(c) 48 cm (d) 49 cm

**101.** A garden is 24 m long and 14 m wide. There is a path 1 m wide outside the garden along its sides. If the path is to be constructed with square marble tiles 20 cm × 20 cm, then find the number of tiles required to cover the path:

(a) 1800 (b) 200
(c) 2000 (d) 2150

**102.** If the length of the diagonal of a rhombus is 80% of the length of the other diagonal, the area of the rhombus is how many times the square of the length of the longer diagonal?

(a) $\frac{4}{5}$ (b) $\frac{2}{5}$
(c) $\frac{3}{4}$ (d) $\frac{1}{4}$

**103.** $ABCD$ is a trapezium in which $AB \parallel CD$ and $AB = 2CD$. If its diagonals intersect each other at $O$, the ratio of the area of triangle $AOB$ and $COD$ is:

(a) 1:2 (b) 2:1
(c) 1:4 (d) 4:1

**104.** The ratio of the corresponding sides of two similar triangles is 3:4. The ratio of their areas is:

(a) 4:3 (b) 3:4
(c) 9:16 (d) $\sqrt{3}:2$

**105.** The area of the circle inscribed in an equilateral triangle of side 24 cm is:

(a) 24 $\pi$ $cm^2$ (b) 36 $\pi$ $cm^2$
(c) 48 $\pi$ $cm^2$ (d) 18 $\pi$ $cm^2$

**106.** The radius of wheel is 1.4 decimetre. How many times does it revolve during a journey of 0.66 Km?

(a) 375 (b) 750
(c) 1500 (d) 3000

## EXERCISE-2
## (BASED ON MEMORY)

**1.** The ratio of the length to breadth of a rectangular plot is 8:5. If the breadth is 60 m less than the length, what is the perimeter of the rectangular plot?

(a) 260 m (b) 1600 m
(c) 500 m (d) Cannot be determined
(e) None of these

**[Bank of Maharashtra PO, 2008]**

**2.** The ratio of the length and the breadth of a rectangular plot is 6:5 respectively; if the breadth of the plot is 34 metre less than the length, what is the perimeter of the rectangular plot?

(a) 374 m (b) 408 m
(c) 814 m (d) 748 m
(e) None of these

**[SBI PO, 2008]**

**3.** The ratio of the length and the breadth of a rectangle is 4:3 and the area of the rectangle is 1728 $cm^2$. What is the ratio of the breadth and the area of the rectangle?

(a) 1:38 (b) 1:24
(c) 1:42 (d) 1:34
(e) None of these

**[Allahabad Bank SO, 2007]**

**4.** A 50 cm wide path is to be made around a circular garden having diameter of 8 m. Approximately, what is the area of the path in $m^2$?

(a) 13 (b) 8
(c) 18 (d) 22
(e) 20

**[PNB Management Trainee, 2007]**

**5.** What will be the area of a circle with circumference equal to 88 cm?

(a) 154 $cm^2$
(b) 44 $cm^2$
(c) 616 $cm^2$
(d) Cannot be determined
(e) None of these

**[Allahabad Bank PO, 2007]**

**6.** The circumference of a circular plot is 396 m. What is the area of the circular plot?

(a) 9856 $m^2$ (b) 18634 $m^2$
(c) 12474 $m^2$ (d) 9446 $m^2$
(e) None of these

**[LIC ADO, 2007]**

**7.** A triangle's perimeter is 25 cm. Which of the following may be true or is a possibility?

(A) The sides are 7 cm, 7 cm and 11 cm.
(B) It is an equilateral triangle.
(C) The value of the sides can be in integer only.

(a) Only A (b) Only A and B
(c) Only C (d) Only B and C
(e) Only B

**[IOB PO, 2006]**

**8.** The area of a rectangle is 12 $m^2$ and its length is 3 times its breadth. What is the perimeter of the rectangle?

(a) 18 m (b) 24 m
(c) 14 m (d) Cannot be determined
(e) None of these

**[IOB PO, 2006]**

**9.** The magnitude of the area of a circle is 7 times that of its circumference. What is the circumference (in units) of the circle?

(a) 616 (b) 132
(c) 88 (d) Cannot be determined
(e) None of these

**[Central Bank of India PO, 2006]**

**10.** Perimeter of a rectangular field is 160 m and the difference between its adjacent sides is 48 m. The side of a square field, having the same area as that of the rectangle, is:

(a) 32 metres (b) 8 metres
(c) 4 metres (d) 16 metres

**[SSC (GL) Prel, 2005]**

**11.** The ratio of the area of a square to that of the square drawn on its diagonal is:

(a) 1:1 (b) 1:2
(c) 1:3 (d) 1:4

**[SSC (GL) Prel, 2005]**

**12.** If the length and breadth of a rectanlge are in the ratio 3:2 and its perimeter is 20 cm, then the area of the rectangle (in $cm^2$) is:

(a) 24 (b) 48
(c) 72 (d) 96

**[SSC (GL) Prel, 2005]**

**13.** The areas of a square and a rectangle are equal. The length of the rectangle is greater than the length of the side of the square by 5 cm and the breadth is less than the length of the side of the square by 3 cm. The perimeter of the rectangle is:

(a) 17 cm (b) 26 cm
(c) 30 cm (d) 34 cm

**[SSC (GL) Prel, 2005]**

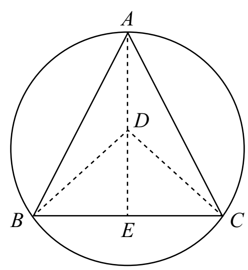
**14.** The area of a square of each side 8 cm is equal to the area of a rectangle. Which of the following statements about the rectangle is/are correct?

(1) The length of the rectangle is 16 times of the breadth.
(2) The length of the rectangle is 32 times of the breadth.
(3) The breadth of the rectangle is $\frac{1}{6}$ of the length.
(4) The breadth of the rectangle is $\frac{1}{9}$ of the length.

(a) Only (1) and (2) (b) Only (3) and (4)
(c) Either (1) or (2) (d) Either (3) or (4)
(e) None of these

**[SBI PO, 2005]**

**15.** In the given figure *ABC* is an equilateral triangle which is inscribed in a circle of radius *r*. Which one of the following is the area of the triangle?




(a) $(r-DE)^{1/2}(r+DE)^2$

(b) $(r-DE)^2(r+DE)^2$

(c) $(r-DE)^{1/2}(r+DE)^{3/2}$

(d) $(r+DE)^{1/2}(r-DE)^{3/2}$

**[SBI PO, 2005]**

**16.** The radius of a circle is 20% more than the height of a right angled triangle. The base of the right angled triangle is 36 cm. If the area of the right angled triangle is equal to the area of the circle, then what is the approximate area of the circle?

(a) 72 $cm^2$ (b) 144 $cm^2$
(c) 216 $cm^2$ (d) 128 $cm^2$
(e) Cannot be determined

**[SBI PO, 2005]**

**17.** In two triangles, the ratio of the areas is 4:3 and that of their heights is 3:4. Find the ratio of their bases.
(a) 16:9 (b) 9:16
(c) 9:12 (d) 16:12

**[SSC (GL) Prel. Examination, 2002]**

**18.** The diagonals of a rhombus are 24 cm and 10 cm. The perimeter of the rhombus (in cm) is:
(a) 68 (b) 65
(c) 54 (d) 52

**[SSC (GL) Prel. Examination, 2002]**

**19.** Find the length of the longest rod that can be placed in a hall of 10 m length, 6 m breadth and 4 m height.
(a) $2\sqrt{38}$ m (b) $4\sqrt{38}$ m
(c) $2\sqrt{19}$ m (d) 19 m

**[SSC (GL) Prel. Examination, 2002]**

**20.** If a wire is bent into the shape of a square, the area of the square is 81 $cm^2$. When the wire is bent into a semi-circular shape, the area of the semi-circle $\left(\text{taking } \pi = \frac{22}{7}\right)$ is:
(a) 154 $cm^2$ (b) 77 $cm^2$
(c) 44 $cm^2$ (d) 22 $cm^2$

**[SSC (GL) Prel. Examination, 2002]**

**21.** The perimeters of two squares are 24 cm and 32 cm. The perimeter (in cm) of a third square which is equal in area to the sum of the areas of the first and second squares is:
(a) 45 (b) 40
(c) 32 (d) 48

**[SSC (GL) Prel. Examination, 2002]**

**22.** The length of a rectangular garden is 12 m and its breadth is 5 m. Find the length of the diagonal of a square garden having the same area as that of the rectangular garden.
(a) $2\sqrt{30}$ m (b) $\sqrt{13}$ m
(c) 13 m (d) $8\sqrt{15}$ m

**[SSC (GL) Prel. Examination, 2002]**

**23.** The base of a triangle is 15 cm and height is 12 cm. The height of another triangle of double the area having base 20 cm is:
(a) 9 cm (b) 18 cm
(c) 8 cm (d) 12.5 cm

**[SSC (GL) Prel. Examination, 2002]**

**24.** The diagonals of a rhombus are 32 cm and 24 cm, respectively. The perimeter of the rhombus is:
(a) 80 cm (b) 72 cm
(c) 68 cm (d) 86 cm

**[SSC (GL) Prel. Examination, 2002]**

**25.** A wire when bent in the form of a square encloses an area of 484 $cm^2$. What will be the enclosed area, when the same wire is bent into the form of a circle? $\left(\text{take } \pi = \frac{22}{7}\right)$
(a) 462 $cm^2$ (b) 539 $cm^2$
(c) 616 $cm^2$ (d) 693 $cm^2$

**[SSC (GL) Prel. Examination, 2002]**

**26.** The perimeter of a square is 48 cm. The area of a rectangle is 4 $cm^2$ less than the area of the square. If the length of the rectangle is 14 cm, then its perimeter is:
(a) 24 cm (b) 48 cm
(c) 50 cm (d) 54 cm

**[SSC (GL) Prel. Examination, 2002]**

**27.** The side and one of the diagonals of a rhombus are 13 cm and 24 cm, respectively. The area of the rhombus (in $cm^2$) is:
(a) 156 (b) 240
(c) 120 (d) 130

**[SSC (GL) Prel. Examination, 2002]**

**28.** A circular wire of radius 21 cm is cut and bent in the form of a rectangle whose sides are in the ratio of 6:5. Assuming $\pi = \frac{22}{7}$, the area enclosed by the rectangle is:
(a) 540 $cm^2$ (b) 1080 $cm^2$
(c) 2160 $cm^2$ (d) 4320 $cm^2$

**[SSC (GL) Prel. Examination, 2002]**

**29.** The area (in $m^2$) of the square which has the same perimeter as of a rectangle whose length is 48 m and is 3 times its breadth, is:
(a) 1000 (b) 1024
(c) 1600 (d) 1042

**[SSC (GL) Prel. Examination, 2002]**

**30.** The area of an equilateral triangle is $400\sqrt{3}$ $m^2$. Its perimeter is:
(a) 120 m (b) 150 m
(c) 90 m (d) 135 m

**[SSC (GL) Prel. Examination, 2003]**

**31.** A took 15 seconds to cross a rectangular field diagonally walking at the rate of 52 m/min and B took the same time to cross the same field along its sides walking at the rate of 68 m/min. The area of the field is:

(a) 30 $m^2$ (b) 40 $m^2$
(c) 50 $m^2$ (d) 60 $m^2$

**[SSC (GL) Prel. Examination, 2003]**

**32.** Diameter of a wheel is 3 m. The wheel revolves 28 times in a minute. To cover 5,280 Km distance, the wheel will take $\left(\text{take } \pi = \dfrac{22}{7}\right)$:

(a) 10 minute (b) 20 minute
(c) 30 minute (d) 40 minute

**[SSC (GL) Prel. Examination, 2003]**

**33.** The sides of a triangle are 3 cm, 4 cm and 5 cm. The area (in $cm^2$) of the triangle formed by joining the mid-points of this triangle is:

(a) 6 (b) 3
(c) $\dfrac{3}{2}$ (d) $\dfrac{3}{4}$

**[SSC (GL) Prel. Examination, 2003]**

**34.** From a point in the interior of an equilateral triangle the perpendicular distance of the sides are $\sqrt{3}$ cm, 2 $\sqrt{3}$ cm respectively and 5 $\sqrt{3}$ cm. The perimeter (in cm) of the triangle is:

(a) 64 (b) 32
(c) 48 (d) 24

**[SSC (GL) Prel. Examination, 2003]**

**35.** Find the diameter of a wheel that makes 113 revolutions to go 2 Km 26 decametres $\left(\text{take } \pi = \dfrac{22}{7}\right)$.

(a) $4\dfrac{4}{13}$ m (b) $6\dfrac{4}{11}$ m

(c) $12\dfrac{4}{11}$ m (d) $12\dfrac{8}{11}$ m

**[SSC (GL) Prel. Examination, 2003]**

**36.** The difference of the areas of two squares drawn on 2 line segments of different lengths is 32 $cm^2$. Find the length of the greater line segment, if one is longer than the other by 2 cm.

(a) 7 cm (b) 9 cm
(c) 11 cm (d) 16 cm

**[SSC (GL) Prel. Examination, 2003]**

**37.** The perimeters of two squares are 40 cm and 32 cm. The perimeter of a third square whose area is, equal to the difference of the areas of the first two squares is:

(a) 24 cm (b) 42 cm
(c) 40 cm (d) 20 cm

**[SSC (GL) Prel. Examination, 2003]**

**38.** The perimeter of a rhombus is 40 cm. If the length of one of its diagonals be 12 cm, the length of the other diagonal is:

(a) 14 cm (b) 15 cm
(c) 16 cm (d) 12 cm

**[SSC (GL) Prel. Examination, 2003]**

**39.** Three circles of radius 3.5 cm each are placed in such a way that each touches the other. The area of the portion enclosed by the circles is:

(a) 1.975 $cm^2$ (b) 1.967 $cm^2$
(c) 19.67 $cm^2$ (d) 21.21 $cm^2$

**[SSC (GL) Prel. Examination, 2003]**

**40.** Four equal-sized maximum circular plates are cut off from a square paper sheet of area 784 $cm^2$. The circumference of each plate is:

(a) 22 cm (b) 44 cm
(c) 66 cm (d) 88 cm

**[SSC (GL) Prel. Examination, 2003]**

**41.** The area of a right-angled triangle is $\dfrac{2}{3}$ of the area of a rectangle. The base of the triangle is 80 per cent of the breadth of the rectangle. If the perimeter of the rectangle is 200 cm, what is the height of the triangle?

(a) 20 cm (b) 30 cm
(c) 15 cm (d) Data inadequate
(e) None of these

**[BSRB Chennai PO, 2000]**

**42.** When the length of a rectangular plot is increased by 4 times, its perimeter becomes 480 metres and area 12800 $m^2$. What was its original length (in m)?

(a) 160 (b) 40
(c) 20 (d) Cannot be determined

**[BSRB Bhopal PO, 2000]**

**43.** Four sheets of 50 cm × 5 cm are to be arranged in such a manner that a square could be formed. What will be the area of inner part of the square so formed?

(a) 2000 $cm^2$ (b) 1600 $cm^2$
(c) 1800 $cm^2$ (d) 2500 $cm^2$
(e) None of these

**[BSRB Bangalore PO, 2000]**

**44.** In order to fence a square Manish fixed 48 poles. If the distance between 2 poles is 5 m, then what will be the area of the square so formed?

(a) Cannot be determined
(b) 3025 $cm^2$
(c) 2500 $cm^2$
(d) 3025 $cm^2$
(e) None of these

**[BSRB Bangalore PO, 2000]**

**45.** What will be the area of semicircle of 14 m diameter?

(a) 154 $m^2$ (b) 77 $m^2$
(c) 308 $m^2$ (d) 22 $m^2$
(e) None of these

**[NABARD Asst. Manager Examination, 2002]**

**46.** The area of a rectangular field is 460 $m^2$. If the length is 15 per cent more than the breadth, what is the breadth of the rectangular field?

(a) 15 m (b) 26 m
(c) 34.5 m (d) Cannot be determined
(e) None of these

**[Canara Bank PO, 2003]**

**47.** The breadth of a rectangular hall is $\frac{2}{3}$ of its length. If the area of the hall is 2400 $m^2$, what is the length in m?

(a) 120 (b) 80
(c) 60 (d) 40
(e) None of these

**[IBPS JR Executive Examination, 2002]**

**48.** The front wheels of a wagon are $2\pi$ feet in circumference and the back wheels are $3\pi$ feet in circumference. When the front wheels have made 10 more revolutions than the back wheels, how many feet has the wagon travelled?

(a) 30 $\pi$ (b) 90 $\pi$
(c) 60 $\pi$ (d) 150 $\pi$

**49.** If the area of a circle is $9\pi$, then which of the following is (are) true?

I. The radius is 3
II. The diameter is 6
III. The circumference is $6\pi$

(a) I only (b) I and II only
(c) I, II and III (d) III only

**50.** The circle with center $O$ has a radius of 4 (See figure in the solution). If the area of the shaded region is $14\pi$, then what is the value of $x$?

(a) 90 (b) 60
(c) 55 (d) 45

**51.** If the radius of a circle is increased by 8%, then the area of the circle is increased by:

(a) 16.64% (b) 12.36%
(c) 6% (d) 3.6%

**52.** The perimeter of a square is equal to twice the perimeter of a rectangle of length 8 cm and breadth 7 cm. What is the circumference of a semicircle whose diameter is equal to the side of the square? (Rounded off to the two decimal place)

(a) 38.57 cm (b) 23.57 cm
(c) 42.46 cm (d) 47.47 cm

**[Punjab and Sindh Bank PO, 2010]**

**53.** The area of a square is 1024 $cm^2$. What is the ratio between the length and the breadth of a rectangle whose length is twice the side of the square and breadth is 12 cm less than the side of the square?

(a) 5:18 (b) 16:7
(c) 14:5 (d) None of these

**[CBI (PO), 2010]**

**54.** The length of a rectangular floor is twice its breadth. If ₹256 is required to paint the floor at the rate of ₹2 per $m^2$, then what would be the length of floor?

(a) 16 m (b) 8 m
(c) 21 m (d) 32 m

**[Corporation Bank PO, 2009]**

**55.** A number when subtracted by $\frac{1}{7}$ of itself gives the same value as the sum of all the angle of a triangle. What is the number?

(a) 224 (b) 210
(c) 140 (d) 350

**[Corporation Bank PO, 2009]**

**56.** What would be the cost of laying a carpet on a floor which has its length and breadth in the respective ratio of 32:21 and where its perimeter is 212 feet, if the cost per square foot of laying the carpet is ₹2.5?

(a) ₹6720 (b) ₹5420
(c) ₹7390 (d) Cannot be determined

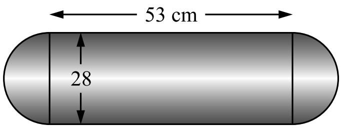
**[Rajasthan Grameen Bank PO, 2011]**

**57.** The circumference of 2 circles is 83 m and 220 m, respectively. What is the difference between the area of the larger circle and the smaller circle?

(a) 3422 $m^2$ (b) 3242 $m^2$
(c) 3244 $m^2$ (d) None of these

**[Corporation Bank PO, 2011]**

**58.** What is the area of the following figure?




(a) 2504 $cm^2$ (b) 1940 $cm^2$
(c) 2100 $cm^2$ (d) Cannot be determined

**59.** The length of a rectangle is twice the diameter of a circle. The circumference of the circle is equal to the area of a square of side 22 cm. What is the breadth of the rectangle if its perimeter is 668 cm?

(a) 24 cm (b) 26 cm
(c) 52 cm (d) Cannot be determined

**[Union Bank of India PO, 2011]**

**60.** Cost of fencing a circular plot at the rate of ₹15 per m is ₹3300. What will be the cost of flooring that plot at the rate of ₹100 per $m^2$?

(a) ₹385000 (b) ₹220000
(c) ₹350000 (d) Cannot be determined

**[United Bank of India PO, 2009]**

**61.** An order was placed for supply of carpet of breadth 3 m, the length of carpet was 1.44 times of breadth. Subsequently the breadth and length were increased by 25% and 40%, respectively. At the rate of ₹45 per $m^2$, what would be the increase in the cost of the carpet?

(a) ₹1002.6 (b) ₹398.8
(c) ₹437.4 (d) ₹583.2

**[IOB PO, 2009]**

**62.** The area of a square is 196 $cm^2$. whose side is half the radius of a circle. The circumference of the circle is equal to breadth of a rectangle, if perimeter of the rectangle is 712 cm. What is the length of the rectangle?

(a) 196 $cm^2$ (b) 186 $cm^2$
(c) 180 $cm^2$ (d) 190 $cm^2$

**[OBC PO, 2010]**

**63.** *ABCD* is a trapezium with *AD* and *BC* parallel sides. *E* is a point on *BC*. The ratio of the area of *ABCD* to that of *AED* is:

(a) $\dfrac{\overline{AD}}{\overline{BC}}$ (b) $\dfrac{\overline{BE}}{\overline{EC}}$

(c) $\dfrac{\overline{AD}+\overline{BE}}{\overline{AD}+\overline{CE}}$ (d) $\dfrac{\overline{AD}+\overline{BC}}{AD}$

**[SSC, 2014]**

**64.** In an equilateral triangle of side 24 cm, a circle is inscribed touching its sides. The area of the remaining portion of the triangle is $\left(\sqrt{3}=1.732\right)$:

(a) 98.55 $cm^2$ (b) 100 $cm^2$
(c) 101 $cm^2$ (d) 95 $cm^2$

**[SSC, 2014]**

**65.** Perimeter of a rhombus is 2*p* units and sum of length of diagonals is *m* units, then area of the rhombus is:

(a) $\frac{1}{4}m^2 p$ sq units

(b) $\frac{1}{4}mp^2$ sq units

(c) $\frac{1}{4}(m^2 - p^2)$ sq units

(d) $\frac{1}{4}(p^2 - m^2)$ sq units

**[SSC, 2014]**

**66.** Two sides of a plot measuring 32 *m* and 24 *m* and the angle between them is a perfect right angle. The other two sides measure 25 *m* each and the other three angles are not right angles. The area of the plot in $m^2$ is:

(a) 768 (b) 534
(c) 696.5 (d) 684

**[SSC, 2014]**

**67.** A is the centre of circle whose radius is 8 and B is the centre of a circle whose diameter is 8. If these two circles touch externally, then the area of the circle with diameter AB is:

(a) 36 $\pi$ (b) 64 $\pi$
(c) 144 $\pi$ (d) 256 $\pi$

**[SSC, 2014]**

**68.** A lawn is in the form of a rectangle having its breadth and length in the ratio 3:4. The area of the lawn is $\frac{1}{12}$ hectare. The breadth of the lawn is:

(a) 25 metres (b) 50 metres
(c) 75 metres (d) 100 metres

**[SSC, 2013]**

**69.** The area of a rectangle is thrice that of a square. The length of the rectangle is 20 cm and the breadth of the rectangle is $\frac{3}{2}$ times that of the side of the square. The side of the square (in cm) is:

(a) 10 (b) 20
(c) 30 (d) 60

**[SSC, 2013]**

**70.** The diagonals of a rhombus are 12 cm and 16 cm. The length of one side is:

(a) 8 cm (b) 6 cm
(c) 10 cm (d) 12 cm

**[SSC, 2013]**

**71.** The diameter of a circular wheel is 7 m. How many revolutions will it make in travelling 22 Km?

(a) 100 (b) 400
(c) 500 (d) 1000

**[SSC, 2013]**

**72.** The area of an equilateral triangle is $9\sqrt{3}$ m$^2$. The length (in m) of the median is:

(a) $2\sqrt{3}$ (b) $3\sqrt{3}$
(c) $3\sqrt{2}$ (d) $2\sqrt{2}$

**[SSC, 2013]**

**73.** How many tiles, each 4 decimetres square, will be required to cover the floor of a room 8 m long and 6 m broad?

(a) 200 (b) 260
(c) 280 (d) 300

**[SSC, 2013]**

**74.** The area of the circumcircle of an equilateral triangle is $3\pi$ cm$^2$. The perimeter of the triangle is:

(a) $3\sqrt{3}$ cm (b) 9 cm
(c) 18 cm (d) 3 cm

**[SSC Assistant Grade III, 2013]**

**75.** In $\Delta ABC$, $\angle A = 90°$ and $AD \perp BC$ where $D$ lies on $BC$. If $BC = 8$ cm, $AC = 6$ cm, then $\Delta ABC : \Delta ACD$ is:

(a) 4:3 (b) 25:16
(c) 16:9 (d) 25:9

**[SSC Assistant Grade III, 2013]**

**76.** The sides of a triangle are in the ratio $\frac{1}{4}:\frac{1}{6}:\frac{1}{8}$ and its perimeter is 91 cm. The difference of the length of the longest side and that of the shortest side is:

(a) 19 (b) 20
(c) 28 (d) 21

**[SSC Assistant Grade III, 2013]**

**77.** The perimeter of an isosceles right-angled triangle is $2p$ cm. Its area is:

(a) $(3+2\sqrt{2})p$ cm$^2$

(b) $(3-2\sqrt{2})p^2$ cm$^2$

(c) $(2-\sqrt{2})p$ cm$^2$

(d) $(2+\sqrt{2})p^2$ cm$^2$

**[SSC Assistant Grade III, 2013]**

**78.** The ratio between the areas of two circles is 4:7. What will be the ratio of their radii?

(a) $2:\sqrt{7}$ (b) 4:7
(c) 16:49 (d) $4:\sqrt{7}$

**[SSC Assistant Grade III, 2013]**

**79.** The perimeter of a non-square rhombus is 20 cm. One of its diagonals is 8 cm. The area of the rhombus is:

(a) 28 cm$^2$ (b) 20 cm$^2$
(c) 22 cm$^2$ (d) 24 cm$^2$

**[SSC Assistant Grade III, 2013]**

**80.** The sides of a triangle are 50 cm, 78 cm and 112 cm. The smallest altitude is:

(a) 20 cm (b) 30 cm
(c) 40 cm (d) 50 cm

**[SSC Assistant Grade III, 2012]**

**81.** In a triangle $ABC$, $AB + BC = 12$ cm, $BC + CA = 14$ cm and $CA + AB = 18$ cm. Find the radius of the circle (in cm) which has the same perimeter as the triangle.

(a) $\frac{5}{2}$ (b) $\frac{7}{2}$

(c) $\frac{9}{2}$ (d) $\frac{11}{2}$

**[SSC, 2012]**

**82.** A playground is in the shape of a rectangle. A sum of ₹1,000 was spent to make the ground usable at the rate of 25 paisa per m$^2$. The breadth of the ground is 50 m. If the length of the ground is increased by 20 m, what will be the expenditure in rupees at the same rate per m$^2$?

(a) 1,250 (b) 1,000
(c) 1,500 (d) 2,250

**[SSC, 2012]**

**83.** The lengths of three medians of a triangle are 9 cm, 12 cm and 15 cm. The area (in cm$^2$) of the triangle is:

(a) 24 (b) 72
(c) 48 (d) 144

**[SSC, 2012]**

**84.** A circle and a rectangle have the same perimeter. The sides of the rectangle are 18 cm and 26 cm. The area of the circle is $\left[\text{Take } \pi = \frac{22}{7}\right]$

(a) 125 cm$^2$ (b) 230 cm$^2$
(c) 550 cm$^2$ (d) 616 cm$^2$

**[SSC, 2012]**

**85.** The area of a circle is increased by 22 $cm^2$ when its radius is increased by 1 cm. The original radius of the circle is:

(a) 3 cm (b) 5 cm
(c) 7 cm (d) 9 cm

**[SSC, 2012]**

**86.** The sum of all interior angles of a regular polygon is twice the sum of all its exterior angles. The number of sides of the polygon is:

(a) 10 (b) 8
(c) 12 (d) 6

**[SSC, 2012]**

**87.** If the diagonals of a rhombus are 8 and 6, then the square of its size is:

(a) 25 (b) 55
(c) 64 (d) 36

**[SSC, 2012]**

**88.** The area of the square inscribed in a circle of radius 8 cm is:

(a) 256 $cm^2$ (b) 250 $cm^2$
(c) 128 $cm^2$ (d) 125 $cm^2$

**[SSC, 2012]**

**89.** A square is of area 200 $m^2$. A new square is formed in such a way that the length of its diagonal is $\sqrt{2}$ times of the diagonal of the given square. Then the area of the new square formed is:

(a) $200\sqrt{2}$ $m^2$ (b) $400\sqrt{2}$ $m^2$
(c) 400 $m^2$ (d) 800 $m^2$

**[SSC, 2011]**

**90.** The sides of a right-angled triangle forming right angle are in the ratio 5:12. If the area of the triangle is 270 $cm^2$, then the length of the hypotenuse is:

(a) 39 cm (b) 42 cm
(c) 45 cm (d) 51 cm

**[SSC, 2010]**

**91.** If the measures of a diagonal and the area of a rectangle are 25 cm and 168 $cm^2$ respectively, what is the length of the rectangle?

(a) 31 cm (b) 24 cm
(c) 17 cm (d) 27 cm

**[SSC, 2010]**

**92.** A General, while arranging his men, who were 6000 in number, in the form of a square, found that there were 71 men leftover. How many were arranged in each row?

(a) 73 (b) 77
(c) 87 (d) 93

**[SSC, 2010]**

**93.** If the length of a rectangle is increased by 10% and its breadth is decreased by 10%, then its area:

(a) decreases by 1%
(b) increases by 1%
(c) decreases by 2%
(d) remains unchanged

**[SSC, 2010]**

**94.** If the length of a rectangle is increased in the ratio 6:7 and its breadth is diminished in the ratio 5:4 then its area will be diminished in the ratio:

(a) 17:16 (b) 15:14
(c) 9:8 (d) 8:7

**[SSC, 2010]**

**95.** 3 horses are tethered at 3 corners of a triangular plot of land having sides 20 m, 30 m and 40 m each with a rope of length 7 m. The area (in $m^2$) of the region of this plot, which can be grazed by the horses, is:

$\left(\text{Use } \pi = \dfrac{22}{7}\right)$

(a) $\dfrac{77}{3}$ (b) 75
(c) 77 (d) 80

**[SSC, 2010]**

**96.** A wire, when bent in the form of a square, encloses a region of area 121 $cm^2$. If the same wire is bent into the form of a circle, then the area of the circle is:

$\left(\text{Use } \pi = \dfrac{22}{7}\right)$

(a) 150 $cm^2$ (b) 152 $cm^2$
(c) 154 $cm^2$ (d) 159 $cm^2$

**[SSC, 2010]**

**97.** The ratio of the area of a sector of a circle to the area of the circle is 1:4. If the area of the circle is 154 $cm^2$, the perimeter of the sector is:

(a) 20 cm (b) 25 cm
(c) 36 cm (d) 40 cm

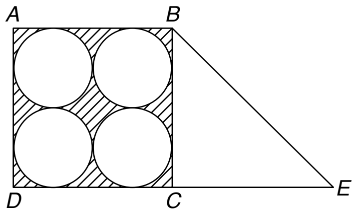
**[SSC, 2010]**

**98.** The sum of the areas of the 10 squares, the lengths of whose sides are 20 cm, 21 cm, ..., 29 cm respectively is:

(a) 6085 $cm^2$ (b) 8555 $cm^2$
(c) 2470 $cm^2$ (d) 11025 $cm^2$

**[SSC, 2010]**

**Directions (Q. 99–100):** Study the following diagram to answer the questions.




**99.** If the diameter of each circle is 14 cm and $DC = CE$, the area of $\Delta BDE$ is:

(a) 784 $cm^2$ (b) 748 $cm^2$
(c) 874 $cm^2$ (d) 441 $cm^2$
(e) None of these

**[IBPS PO/MT, 2013]**

**100.** The area of the shaded region of square *ABCD* is:

(a) 186 $cm^2$ (b) 168 $cm^2$
(c) 188 $cm^2$ (d) 441 $cm^2$
(e) None of these

**[IBPS PO/MT, 2013]**

**101.** The area of a square is 1444 square metres. The breadth of a rectangle is $\frac{1}{4}$ the side of the square and the length of the rectangle is thrice its breadth. What is the difference between the area of the square and the area of the rectangle?

(a) 1152.38 $m^2$ (b) 1169.33 $m^2$
(c) 1181.21 $m^2$ (d) 1173.25 $m^2$
(e) None of these

**[IBPS PO/MT, 2012]**

**102.** If the length of a rectangular field is increased by 20% and the breadth is reduced by 20%, the area of the rectangle will be 192 $m^2$. What is the area of the original rectangle?

(a) 184 $m^2$ (b) 196 $m^2$
(c) 204 $m^2$ (d) 225 $m^2$
(e) None of these

**[SBI Associates Banks PO, 2011]**

**103.** Inside a square plot, a circular garden is developed which exactly fits in the square plot and the diameter of the garden is equal to the side of the square plot which is 28 m. What is the area of the space left out in the square plot after developing the garden?

(a) 98 $m^2$ (b) 146 $m^2$
(c) 84 $m^2$ (d) 168 $m^2$
(e) None of these

**[SBI Associates Banks PO, 2011]**

**104.** What is the cost of flooring a rectangular hall?

**Statements:**

**I.** The length of the rectangle is 6 meters.
**II.** The breadth of the rectangle is 2/3 of its length.
**III.** The cost of flooring the area of 100 $cm^2$ is ₹45.

(a) Only I and III
(b) Only II and III
(c) All I, II and III
(d) Question cannot be answered even with data in all three statements.
(e) None of these

**[SBI Associates Banks PO, 2011]**

**105.** The length of a rectangle is 3/5 of the side of a square. The radius of a circle is equal to side of the square. The circumference of the circle is 132 cm. What is the area of the rectangle if the breadth of the rectangle is 8 cm?

(a) 112.4 $cm^2$ (b) 104.2 $cm^2$
(c) 100.8 $cm^2$ (d) Cannot be determined
(e) None of these

**[IOB PO, 2011]**

**106.** The smallest side of a right-angled triangle is 8 cm less than the side of a square of perimeter 56 cm. The second largest side of the right-angled triangle is 4 cm less than the length of the rectangle of area 96 $cm^2$ and breadth 8 cm. What is the largest side of the right-angled triangle?

(a) 20 cm (b) 12 cm
(c) 10 cm (d) 15 cm
(e) None of these

**[IOB PO, 2011]**

**107.** The sum of the circumference of a circle and the perimeter of a square is equal to 272 cm. The diameter of the circleis 56 cm. What is the sum of the areas of the circle and the square?

(a) 2464 $cm^2$ (b) 2644 $cm^2$
(c) 3040 $cm^2$ (d) Cannot be determined
(e) None of these

**[Allahabad Bank PO, 2011]**

**108.** The largest and the second largest angles of a triangle are in the ratio of 4: 3. The smallest angle is half the largest angle. What is the difference between the smallest and the largest angles of the triangle?

(a) 30° (b) 60°
(c) 40° (d) 20°
(e) None of these

**[Allahabad Bank PO, 2011]**

**109.** The ratio of the 3 angles of a quadrilateral is 13:9:5. The value of the 4 angle of the quadrilateral is 36°. What is the difference between the largest and the second smallest angles of the quadrilateral?

(a) 104° (b) 108°
(c) 72° (d) 96°
(e) None of these

**[Allahabad Bank PO, 2011]**

**110.** The circumference of two circles is 88 metres and 220 metres respectively. What is the difference between the area of the larger circle and that of the smaller circle?

(a) 3422 $m^2$
(b) 3242 $m^2$
(c) 3244 $m^2$
(d) 3424 $m^2$
(e) None of these

**[Corporation Bank PO, 2011]**

**111.** The angles of a quadrilateral are in the ratio of 2:4:7:5. The smallest angle of the quadrilateral is equal to the smallest angle of a triangle. One of the angles of the triangle is twice the smallest angle of the triangle. What is the second largest angle of the triangle?

(a) 80° (b) 60°
(c) 120° (d) Cannot be determined
(e) None of these

**[Central Bank of India PO, 2010]**

**112** The area of a square is 1024 $cm^2$. What is the ratio of the length to the breadth of a rectangle whose length is twice the side of the square and breadth is 12 cm less than the side of this square?

(a) 5:18 (b) 16:7
(c) 14:5 (d) 32:5
(e) None of these

**[Central Bank of India PO, 2010]**

**113.** The perimeter of a square is equal to twice the perimeter of a rectangle whose dimensions are: length 8 cm and breadth 7 cm. What is the circumference of a semicircle whose diameter is equal to the side of the square?

(Rounded off of the decimal place)

(a) 38.57 cm
(b) 23.57 cm
(c) 42.46 cm
(d) 47.47 cm
(e) None of these

**[Punjab and Sind Bank PO, 2010]**

**114.** The circumferences of two circles are 132 metres and 176 metres respectively. What is the difference between the area of the larger circle and that of the smaller circle?

(a) 1048 $m^2$
(b) 1076 $m^2$
(c) 1078 $m^2$
(d) 1090 $m^2$
(e) None of these

**[Indian Bank PO, 2010]**

**115.** If the perimeter of a square is equal to the radius of a circle whose area is 39424 $cm^2$, what is the area of the square?

(a) 1225 $cm^{2v}$
(b) 441 $cm^2$
(c) 784 $cm^2$
(d) Cannot be determined
(e) None of these

**[IDBI Bank PO, 2009]**

**116.** What would be the cost of building a fence around a square plot with area equal to 361 sq.ft., if the price per foot of building the fence is ₹62?

(a) ₹4026 (b) ₹4712
(c) ₹3948 (d) Cannot be determined
(e) None of these

**[OBC PO, 2009]**

**117.** The length of a rectangular floor is twice its breadth. If ₹256 is required to paint the floor at the rate of ₹2 per square metre, then what would be the length of floor?

(a) 16 metres (b) 8 metres
(c) 12 metres (d) 32 metres
(e) 20 metres

**[Corporation Bank PO, 2009]**

**118.** What is the area of a given right-angled triangle?

I. The length of the hypotenuse is 5 cm.
II. The perimeter of the triangle is four times that of itsbase.
III. Oneof the angles of the triangle is 60°.

(a) Only II (b) Only III
(c) Either II or III (d) Both I and III
(e) Question cannot be answered even with the information in all three statements

**[IBPS PO/MT, 2013]**

## ANSWER KEYS

### EXERCISE–1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (a) | **3.** (b) | **4.** (b) | **5.** (c) | **6.** (a) | **7.** (b) | **8.** (c) | **9.** (a) | **10.** (c) | **11.** (c) | **12.** (c) | **13.** (c) |
| **14.** (c) | **15.** (a) | **16.** (c) | **17.** (c) | **18.** (b) | **19.** (a) | **20.** (b) | **21.** (b) | **22.** (c) | **23.** (b) | **24.** (c) | **25.** (c) | **26.** (a) |
| **27.** (c) | **28.** (a) | **29.** (c) | **30.** (b) | **31.** (a) | **32.** (b) | **33.** (c) | **34.** (a) | **35.** (b) | **36.** (a) | **37.** (a) | **38.** (c) | **39.** (b) |
| **40.** (b) | **41.** (a) | **42.** (d) | **43.** (d) | **44.** (c) | **45.** (a) | **46.** (c) | **47.** (d) | **48.** (c) | **49.** (c) | **50.** (d) | **51.** (c) | **52.** (b) |
| **53.** (c) | **54.** (c) | **55.** (a) | **56.** (a) | **57.** (c) | **58.** (c) | **59.** (b) | **60.** (b) | **61.** (a) | **62.** (c) | **63.** (b) | **64.** (a) | **65.** (d) |
| **66.** (d) | **67.** (b) | **68.** (c) | **69.** (c) | **70.** (c) | **71.** (c) | **72.** (b) | **73.** (c) | **74.** (b) | **75.** (b) | **76.** (d) | **77.** (b) | **78.** (c) |
| **79.** (d) | **80.** (a) | **81.** (b) | **82.** (d) | **83.** (a) | **84.** (b) | **85.** (b) | **86.** (d) | **87.** (a) | **88.** (c) | **89.** (a) | **90.** (c) | **91.** (b) |
| **92.** (a) | **93.** (b) | **94.** (c) | **95.** (b) | **96.** (a) | **97.** (b) | **98.** (b) | **99.** (b) | **100.** (d) | **101.** (c) | **102.** (b) | **103.** (d) | **104.** (c) |
| **105.** (c) | **106.** (b) | | | | | | | | | | | |

### EXERCISE–2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (e) | **2.** (d) | **3.** (e) | **4.** (a) | **5.** (c) | **6.** (c) | **7.** (b) | **8.** (e) | **9.** (c) | **10.** (a) | **11.** (b) | **12.** (a) | **13.** (c) |
| **14.** (c) | **15.** (c) | **16.** (a) | **17.** (a) | **18.** (d) | **19.** (a) | **20.** (b) | **21.** (b) | **22.** (a) | **23.** (b) | **24.** (a) | **25.** (c) | **26.** (b) |
| **27.** (c) | **28.** (b) | **29.** (b) | **30.** (a) | **31.** (d) | **32.** (b) | **33.** (c) | **34.** (c) | **35.** (b) | **36.** (b) | **37.** (a) | **38.** (c) | **39.** (b) |
| **40.** (b) | **41.** (d) | **42.** (b) | **43.** (e) | **44.** (e) | **45.** (b) | **46.** (e) | **47.** (c) | **48.** (c) | **49.** (c) | **50.** (d) | **51.** (a) | **52.** (a) |
| **53.** (d) | **54.** (a) | **55.** (b) | **56.** (a) | **57.** (d) | **58.** (c ) | **59.** (b) | **60.** (a) | **61.** (c) | **62.** (c) | **63.** (d) | **64.** (a) | **65.** (c) |
| **66.** (d) | **67.** (a) | **68.** (a) | **69.** (a) | **70.** (c) | **71.** (d) | **72.** (b) | **73.** (d) | **74.** (d) | **75.** (c) | **76.** (d) | **77.** (b) | **78.** (a) |
| **79.** (d) | **80.** (b) | **81.** (b) | **82.** (a) | **83.** (b) | **84.** (d) | **85.** (a) | **86.** (d) | **87.** (a) | **88.** (c) | **89.** (c) | **90.** (a) | **91.** (b) |
| **92.** (b) | **93.** (a) | **94.** (b) | **95.** (c) | **96.** (c) | **97.** (b) | **98.** (a) | **99.** (a) | **100.** (b) | **101.** (d) | **102.** (e) | **103.** (d) | **104.** (c) |
| **105.** (c) | **106.** (c) | **107.** (c) | **108.** (c) | **109.** (d) | **110.** (e) | **111.** (b) | **112.** (e) | **113.** (a) | **114.** (c) | **115.** (c) | **116.** (b) | **117.** (a) |
| **118.** (d) | | | | | | | | | | | | |

## EXPLANATORY ANSWERS

### EXERCISE-1

**1. (c)** Let, $a = 15$ m, $b = 16$ m, $c = 17$ m.

Then, $s = \dfrac{a+b+c}{2} = \dfrac{15+16+17}{2} = 24$ m.

$\therefore$ Area $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{24(24-15)(24-16)(24-17)}$

$= \sqrt{24 \times 9 \times 8 \times 7}$

$= \sqrt{12096} = 24\sqrt{21}$ m$^2$.

**2. (a)** Height of the triangle $= \sqrt{(6.5)^2 - 6^2}$

$= \sqrt{42.25 - 36}$

$= \sqrt{6.25} = 2.5$ m

$\therefore$ Area $= \dfrac{1}{2}$ (base $\times$ height)

$= \dfrac{1}{2} \times 6 \times 2.5 = 7.5$ m$^2$.

**3. (b)** Each side = 12 cm

Then, $s = \dfrac{12+12+12}{2} = 18$.

Area $= \sqrt{18(18-12)(18-12)(18-12)}$

$= \sqrt{18 \times 6 \times 6 \times 6} = \dfrac{1}{2} \times 12 \times$ height

or, height $= \dfrac{36\sqrt{3}}{6} = 6\sqrt{3}$ cm.

**4.** **(b)** Let, the length of equal sides be $x$.

Then, $s = \dfrac{x+x+64}{2} = x + 32.$

Area = 1600 m$^2$.

$$= \sqrt{(x+32)(x+32-x)(x+32-x)(x+32-64)}$$

$$= \sqrt{(x+32)\times 32\times 32\times (x-32)}$$

or, $1600 = 32\sqrt{x^2-32^2}$

$\Rightarrow \sqrt{x^2-32^2} = 50$

or, $x^2 = 32^2 + 50^2 = 1024 + 2500 = 3524.$

$\therefore$ $x = 59.36$ m.

**5.** **(c)** Here, $s = \dfrac{20+21+29}{2} = \dfrac{70}{2} = 35$ m.

$\therefore$ Area $= \sqrt{35(35-20)(25-21)(35-29)}$

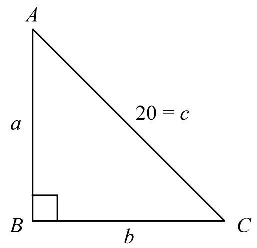
$= \sqrt{35\times 15\times 14\times 6}$

$= \sqrt{5^2\times 7^2\times 3^2\times 2^2}$

$= 5 \times 7 \times 3 \times 2 = 210$ m$^2$.

**6.** **(a)** We have, $a + b + 20 = 2 \times 24$

$\therefore$ $a + b = 28$ ...(1)




By Pythagores Theorem, $a^2 + b^2 = 400$

$\because$ $(a + b)^2 = 28^2$

$\Rightarrow ab = \dfrac{28^2-(a^2+b^2)}{2} = \dfrac{28^2-400}{2} = 192$

$\therefore$ $a - b = \sqrt{(a+b)^2-4ab}$

$= \sqrt{784-4\times 192} = 4$ ...(2)

Solving (1) and (2), we get

$a = 16$ cm and $b = 12$ cm.

**7.** **(b)** The sides of the triangle are

$a = \dfrac{3}{12} \times 36 = 9$ cm, $b = \dfrac{4}{12} \times 36 = 12$ cm

$c = \dfrac{5}{12} \times 36 = 15$ cm

$s = \dfrac{a+b+c}{2} = \dfrac{36}{2} = 18$ cm

$\therefore$ Area $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{18(18-9)(18-12)(18-15)}$

$= \sqrt{18\times 9\times 6\times 3}$

$= \sqrt{9^2\times 2^2\times 3^2} = 9 \times 2 \times 3 = 54$ cm$^2$.

**8.** **(c)** We have, $2s = 50 + 78 + 112 = 240$

$\therefore$ $s = 120.$

$\therefore$ Area $= \sqrt{120(120-50)(120-78)(120-112)}$

$= \sqrt{120\times 70\times 42\times 8}$

$= \sqrt{2^3\times 5\times 3\times 7\times 5\times 2\times 2\times 7\times 3\times 2^3}$

$= 2^4 \times 5 \times 3 \times 7 = 1680$ m$^2$

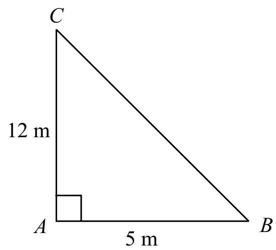
$\therefore$ $\dfrac{1}{2} \times 112 \times h = 1680,$

where $h$ is the length of perpendicular

$\therefore$ $h = \dfrac{1680\times 2}{112} = 30$ m.

**9.** **(a)** Let, $BC$ be the ladder.

Then, $BC = \sqrt{12^2+5^2} = 13$ m.

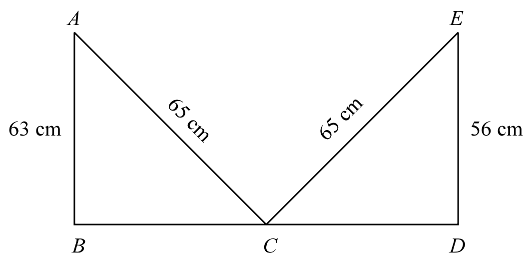



**10.** **(c)** $BC = \sqrt{(65)^2-(63)^2} = 16$

$CD = \sqrt{(65)^2-(56)^2} = 33.$

$\therefore$ Width of the street

$= 16 + 33 = 49$ cm.




**11.** **(c)** Given: $\dfrac{1}{2} \times x \times h = x^2$

$\therefore$ $h = 2x.$

**12.** **(c)** Let, the base be $3x$.

Then, the height is $4x$.

Given: $\dfrac{1}{2} \times 3x \times 4x = 150 \Rightarrow x = 5.$

$\therefore$ Base $= 3 \times 5 = 15$ m and height $= 4 \times 5 = 20$ m.

**13.** **(c)** Area of field $= \dfrac{495.72}{36.72} \times 10000$

$= 135000$ m$^2$

Let, the height be $x$.

Then, base = $3x$.

We have, $\frac{1}{2} \times x \times 3x = 135000$

$\Rightarrow$ $x^2 = 90000$ or $x = 300$.

$\therefore$ Height = 300 m and base = $3 \times 300 = 900$ m.

**14. (c)** Let, the original sides be $a$, $b$, $c$, then

$s = \frac{1}{2}(a + b + c)$

and area of the triangle = $\sqrt{s(s-a)(s-b)(s-c)}$

For the new triangle, the sides are $2a$, $2b$, $2c$.

Then, $S = \frac{1}{2}(2a + 2b + 2c) = a + b + c = 2s$.

$\therefore$ Area of new triangle

$$= \sqrt{S(S-2a)(S-2b)(S-2c)}$$

$$= \sqrt{2s(2s-2a)(2s-2b)(2s-2c)}$$

$$= \sqrt{16s(s-a)(s-b)(s-c)}$$

$$= 4\sqrt{s(s-a)(s-b)(s-c)}$$

= $4 \times$ (area of original triangle).

**15. (a)** The third side of the triangle

= $324 - (85 + 154) = 85$ m.

Also, $s = \frac{a+b+c}{2} = \frac{324}{2} = 162$.

$\therefore$ Area of the triangle

$$= \sqrt{s(s-a)(s-b)(s-c)}$$

$$= \sqrt{162(162-85)(162-85)(162-154)}$$

$$= \sqrt{162 \times 77 \times 77 \times 8} = 2772 \text{ m}^2.$$

$\therefore$ The cost of ploughing the field

= $2772 \times 10$ = ₹27720.

**16. (c)** The area of the equilateral triangle

$$= \frac{\sqrt{3}}{4}(\text{side})^2 = \frac{\sqrt{3}}{4} \times (2\sqrt{3})^2$$

$= 3\sqrt{3}$ cm$^2$.

**17. (a)** Height of the equilateral triangle = $\frac{\sqrt{3}}{2} \times (\text{side})$

$\Rightarrow$ $2\sqrt{3} = \frac{\sqrt{3}}{2} \times (\text{side})$

$\therefore$ Side of the equilateral triangle = 4 cm.

**18. (b)** $3 \times (\text{side}) = 12 \Rightarrow$ side = 4 m.

$\therefore$ Area of equilateral triangle = $\frac{\sqrt{3}}{4}$ (side)$^2$

$$= \frac{\sqrt{3}}{4} \times 16 = 4\sqrt{3} \text{ m.}$$

**19. (a)** $3 \times (\text{side}) = 24 \Rightarrow$ side = 8 cm.

$\therefore$ Height of the equilateral triangle

$$= \frac{\sqrt{3}}{2} \times (\text{side}) = \frac{\sqrt{3}}{2} \times 8 = 4\sqrt{3} \text{ cm.}$$

**20. (b)** Let, $x$ and $(51 - x)$ be the other two sides of the triangle

Then, $x^2 + (51 - x)^2 = 39^2$

$\Rightarrow$ $x^2 + 2601 - 102x + x^2 = 1521$

$$\Rightarrow \quad x = \frac{51 \pm \sqrt{441}}{2} = \frac{51 \pm 21}{2} = 36, 15.$$

$\therefore$ The other two sides are 36 cm and 15 cm.

**21. (b)** Given: $a = \frac{5}{8}b$.

Now, perimeter of isosceles triangle = $2a + b$

$\Rightarrow$ $306 = 2 \times \frac{5}{8}b + b$ or, $b = 136$.

$\therefore$ $a = \frac{5}{8}b = \frac{5}{8} \times 136 = 85$.

$\therefore$ Area of isosceles triangle = $\frac{b}{4}\sqrt{4a^2 - b^2}$

$$= \frac{136}{4}\sqrt{4 \times (85)^2 - (136)^2}$$

$= 34 \times 102 = 3468$ m$^2$.

**22. (c)** We have, hypotenuse = $\sqrt{2}\,a = 8 \Rightarrow a = 8/\sqrt{2}$.

$\therefore$ Area of isosceles triangle = $\frac{1}{2}a^2$

$$= \frac{1}{2} \times \frac{64}{2} = 16 \text{ cm}^2.$$

**23. (b)** Let, the lateral side = $5x$ and the base = $4x$.

Then, $5x + 5x + 4x = 14 \Rightarrow x = 1$.

$\therefore$ The sides of the triangle are 5 cm, 5 cm and 4 cm.

$\therefore$ Area of the isosceles triangle

$$= \frac{b}{4}\sqrt{4a^2 - b^2}$$

$$= \frac{4}{4}\sqrt{4(5)^2 - (4)^2} = \sqrt{84} = 2\sqrt{21} \text{ cm}^2.$$

**24. (c)** Area = $\sqrt{s(s-a)(s-b)(s-c)} = A$

where $s = \frac{a+b+c}{2}$ and $a$, $b$, $c$ are sides of the triangle.

When the sides are increased by 200%, the sides become $3a$, $3b$ and $3c$.

$$s_1 = \frac{3a + 3b + 3c}{2} = 3\frac{(a+b+c)}{2} = 3s.$$

$A_1 = \sqrt{s_1(s_1-3a)(s_1-3b)(s_1-3c)}$

$= \sqrt{3s.3(s-a).3(s-b).3(s-c)}$

$= 9\sqrt{s(s-a)(s-b)(s-c)} = 9A.$

$\therefore$ Increase in area = $9A - A = 8A$ or, 800%

**25.** **(c)** Let, the length of each of equal sides of the triangle be $x$ m.

Then, $x^2 + x^2 = (50\sqrt{2})^2 = 5000$.

$\Rightarrow$ $2x^2 = 5000 \Rightarrow x = 50$.

$\therefore$ Perimeter of the triangle = $50 + 50 + 50\sqrt{2}$

$= 100 + 50 \times 1.4146 = 170.73$ m.

$\therefore$ Cost of fencing = ₹(170.73 × 3) = ₹512.19.

**26.** **(a)** Area of isosceles triangle = $\frac{b}{4}\sqrt{4a^2-b^2}$

$= \frac{16}{4}\sqrt{4\times(10)^2-(16)^2} = 4 \times 12 = 48 \text{ cm}^2$

Given: Area of equilateral triangle = 48.

$\Rightarrow$ $\frac{\sqrt{3}}{4}(\text{side})^2 = 48$

$\Rightarrow$ Side of equilateral triangle = 10.5 cm.

**27.** **(c)** Perimeter of a right-angled isosceles triangle

$= (\sqrt{2}+1) \times$ hypotenuse

$\Rightarrow$ $4\sqrt{2} + 4 = (\sqrt{2} + 1) \times$ hypotenuse

$\Rightarrow$ hypotenuse = 4 m.

**28.** **(a)** Here, $a = 60$, $b = 40$ and $d = 80$

$\therefore$ $s = \frac{a+b+d}{2} = \frac{60+40+80}{2} = 90.$

$\therefore$ Area of the parallelogram

$= 2\sqrt{s(s-a)(s-b)(s-d)}$

$= 2\sqrt{90(90-60)(90-40)(90-80)}$

$= 2\sqrt{90\times30\times50\times10}$

$= 600\sqrt{15} \text{ m}^2.$

**29.** **(c)** Area of the parallelogram

$= 16 \times 14 = 224 \text{ cm}^2.$

**30.** **(b)** We have, $s = \frac{a+b+d}{2}$

$= \frac{65+119+156}{2} = 170.$

$\therefore$ Area of parallelogram

$= 2\sqrt{s(s-a)(s-b)(s-d)}$

$= 2\sqrt{170(170-65)(170-119)(170-156)}$

$= 2\sqrt{170\times51\times105\times14}$

$= 2 \times 3570 = 7140 \text{ m}^2.$

$\therefore$ Cost of gravelling = 7140 × 10 = ₹71400.

**31.** **(a)** The area of the parallelogram

$= 10 \times 7 = 70 \text{ m}^2.$

**32.** **(b)** Area of the parallelogram = $8 \times 4 = 32 \text{ m}^2$.

Distance between the shorter sides = $\frac{32}{5} = 6.4$ m.

**33.** **(c)** Area of quadrilateral = $\frac{1}{2}d(p_1 + p_2)$

$\Rightarrow$ $420 = \frac{1}{2}\times d\times(18+12)$

$\Rightarrow$ $d = \frac{420\times2}{30} = 28$ m.

**34.** **(a)** Let, the base be $x$ and altitude be $2x$.

Then, $x \times 2x = 72 \Rightarrow x^2 = 36 \Rightarrow x = 6$.

**35.** **(b)** Let, the base be $x$.

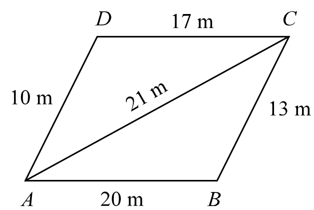
Area of the parallelogram = base × altitude

$\Rightarrow$ $240 = x \times 12$

$\therefore$ $x = \frac{240}{12} = 20$ cm.

**36.** **(a)** Area of quadrilateral $ABCD$

= Area of $\Delta ADC$ + Area of $\Delta ABC$, where,




Area of $\Delta ABC$

$= \sqrt{s(s-AB)(s-BC)(s-d)}$

$\left(s = \frac{AB+BC+d}{2} = \frac{20+13+21}{2} = 27\right)$

$= \sqrt{27(27-20)(27-13)(27-21)}$

$= \sqrt{27\times7\times14\times6} = 126 \text{ m}^2.$

Area of $\Delta ADC$

$= \sqrt{s(s-AD)(s-DC)(s-d)}$

$\left(s = \frac{AD+DC+d}{2} = \frac{10+17+21}{2} = 24\right)$

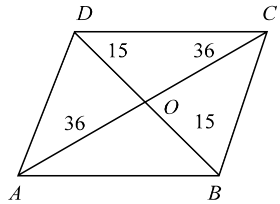
$= \sqrt{24(24-10)(24-17)(24-21)}$

$= \sqrt{24\times14\times7\times3} = 84 \text{ m}^2.$

Here, the area of quadrilateral $ABCD$

$= 126 + 84 = 210 \text{ m}^2.$

**37. (a)** Since $AC = 72$ and $BD = 30$




$\therefore \quad OB = OD = \dfrac{BD}{2} = \dfrac{30}{2} = 15$

and, $OA = OC = \dfrac{AC}{2} = \dfrac{72}{2} = 36$

$\therefore \quad AB = BC = CD = DA = \sqrt{36^2 + 15^2}$

$= \sqrt{1296 + 225}$

$= \sqrt{1521} = 39.$

$\therefore$ Perimeter of the parallelogram $= 4 \times 39$

$= 156$ cm.

**38. (c)** Area of the parallelogram

= base × altitude

$\Rightarrow \quad (x^2 - 4) = (x + 4) \times (x - 3)$

$\Rightarrow \quad x^2 - 4 = x^2 + 4x - 3x - 12$

$\Rightarrow \quad x = 8.$

$\therefore$ Area of the parallelogram

$= x^2 - 4 = (8)^2 - 4 = 60$ sq units.

**39. (b)** We have,

$d_1^2 + d_2^2 = 2(a^2 + b^2)$

$\Rightarrow \quad (16)^2 + d_2^2 = 2(12^2 + 14^2)$

$\Rightarrow \quad d_2^2 = 2(144 + 196) - 256 = 424.$

$\therefore \quad d^2{}_2 = \sqrt{424} = 20.6$ cm.

**40. (b)** $\pi r^2 = 154 \text{ m}^2$

$\Rightarrow r^2 = \dfrac{7}{22} \times 154 \text{ m}^2 = 49 \text{ m}^2$

$\therefore \quad r = 7$ m

Perimeter $= 2 \times \dfrac{22}{7} \times 7 \text{ m} = 44$ m.

**41. (a)** If $x$ be the side of the square and $r$ be the radius of the circle, then,

$4x = 2\pi r$

or, $\quad x = \dfrac{\pi r}{2}$

Now, $\pi r^2 :: x^2 = \pi r^2 :: \dfrac{\pi^2 r^2}{4}$ or, $4:\pi$

$= 4 :: \dfrac{22}{7}$ or, 14:11.

**42. (d)** Let, the width of the rectangle be $x$ m

Then length $= 3x$ m

Perimeter $= 2(x + 3x) = 96$

$\Rightarrow \quad 8x = 96$ or, $x = 12$

Area $= 12 \times 36 = 432 \text{ m}^2$.

**43. (d)** As the cow is tied at the corner of a rectangular field, it will graze the area of the field enclosed between the two sides of the rectangle.

$= \dfrac{1}{4}(\pi \times 14 \times 14)$

$= \dfrac{1}{4} \times \dfrac{22}{7} \times 14 \times 14$

$= 154 \text{ m}^2.$

**44. (c)** The distance covered by the wheel in one minute

$= \dfrac{66 \times 1000 \times 100}{60} = 110000$ cm

The distance covered by the wheel in one revolution

= The circumference of the wheel

$= 2\pi r = 2 \times \dfrac{22}{7} \times \dfrac{70}{2} = 220$ cm

$\therefore$ Number of revolutions of the wheel

$= \dfrac{110000}{220} = 500.$

**45. (a)** $\pi(8)^2 + \pi(6)^2 = \pi r^2$

$\therefore \quad r^2 = 64 + 36$

$r = 10$

**46. (c)** Area of two paths $= 2 \times (65 + 50 - 2) = 226 \text{ m}^2$

Cost of construction $= 226 \times 17.25$

$=$ ₹3898.50.

**47. (d)** $\dfrac{1}{2}(75 + x) \times 40 = 2500$

$\Rightarrow \quad 75 + x = 125$

$\Rightarrow \quad x = 50$

$\therefore$ The other parallel side = 50 m.

**48. (c)** Let, the breadth be $x$, then length $= x + 3$

Given: $2(x + x + 3) = x(x + 3)$

$\Rightarrow \quad 4x + 6 = x^2 + 3x$

$\Rightarrow \quad 4x + 6 = x^2 + 3x$

$\Rightarrow \quad x^2 - x - 6 = 0$

$\therefore \quad x = \dfrac{1 \pm \sqrt{1 + 24}}{2} = \dfrac{1 \pm 5}{2}$

$\therefore \quad x = 3, -2$

$\therefore$ Breadth = 3 cm.

**49. (c)** Let, $x$, $y$ be the sides of squares

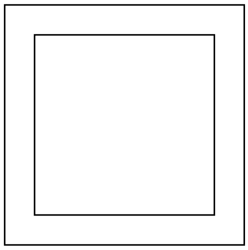
$\dfrac{x^2}{y^2} = \dfrac{9}{1} \Rightarrow \dfrac{x}{y} = \dfrac{3}{1}$

$\therefore$ The ratio of perimeters is $4x:4y$

i.e., $x:y = 3:1$.

**50.** **(d)** Let, $x$ (in metres) be the width of the path

Side of outer square = $30 + 2x$



$\therefore$ Area of path = $(30 + 2x)^2 - 30^2$

$\therefore$ $(30 + 2x)^2 - 30^2 = 256$

$\Rightarrow$ $4x^2 + 12x - 256 = 0$

$\Rightarrow$ $x^2 + 30x - 64 = 0$

$\Rightarrow$ $(x - 2)(x + 32) = 0$

$\therefore$ $x = 2$ $(\because x < 0)$

**51.** **(c)** Additional grassy ground grazed

$= \pi(23^2 - 12^2)$ m$^2$

$= \frac{22}{7} \times 35 \times 11$

$= 1210$ m$^2$.

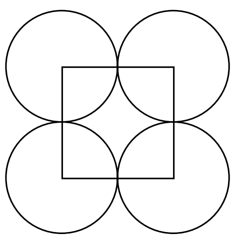
**52.** **(b)** Required area enclosed

$= 14 \times 14 - 4 \times$ (area of a quadrant)

$= \left[196 - 4 \times \frac{22}{7} \times 7 \times 7 \times \frac{90}{360}\right]$ cm$^2$

$= (196 - 154)$ cm$^2$

$= 42$ cm$^2$.



**53.** **(c)** Area $= \frac{6000 \times 100}{25} = 24000$ m$^2$

Let, the length be $5x$ and breadth be $3x$

$\therefore$ $5x \times 3x = 24000$

$\therefore$ $x = \sqrt{1600} = 40$

$\therefore$ Length $= 5 \times 40 = 200$ m, breadth $= 3 \times 40$
$= 120$ m.

**54.** **(c)** Area of the carpet $= \frac{105}{3.50} = 30$ m$^2$

Area of the room = 30 m$^2$

Width = 5 m

$\therefore$ Length $= \frac{30}{5} = 6$ m.

**55.** **(a)** Area of the rectangular field

$= \frac{28000}{3500} = 8$ hectares

$2x \times x = 80000$

$\therefore$ $x = \sqrt{40000} = 200$

$\therefore$ Breadth = 200 m

Length = 400 m

Perimeter = 2(400 + 200) = 1200 m

$\therefore$ Cost of fencing = $1200 \times 5$ = ₹6000.

**56.** **(a)** Let, the length and breadth be $6x$ and $5x$ m respectively. Then

$6x \times 5x = 27000$ or $30x^2 = 27000$

$\Rightarrow$ $x^2 = 900$ or $x = 30$

Hence, length of the field = 180 m and width = 150 m.

**57.** **(c)** Area of sector $= \left(\frac{1}{2} \times \text{arc length} \times \text{radius}\right)$ cm$^2$

$= \left(\frac{1}{2} \times 3.5 \times 5\right)$ cm$^2$

$= 8.75$ cm$^2$.

**58.** **(c)** Area of the plot $= 150 \times 3 = 450$ m$^2$

If the length of the plot be $x$ m then breadth

$= \frac{x}{2}$ m

$\therefore$ $x \times \frac{x}{2} = 450$

or, $x^2 = 900$

or, $x = 30$ m.

**59.** **(b)** Perimeter of circle $= 2 \times \frac{22}{7} \times 7$

$= 44$ cm

Perimeter of half circle = 22 cm

The length of the wire = 22 + 14 = 36 cm.

**60.** **(b)** $2\pi R - 2\pi r = 66$

$2\pi(R - r) = 66$

$2 \times \frac{22}{7} \times (R - r) = 66$

or, $R - r = 66 \times \frac{7}{22} \times \frac{1}{2} = \frac{21}{2} = 10.5$ m.

**61.** **(a)** One side of the square $= \sqrt{50} = 5\sqrt{2}$

Length of diagonal $= 5\sqrt{2} \times \sqrt{2} = 10$

Radius of circle = 5

$\therefore$ Area of the circle $= 25\pi$ units.

**62.** **(c)** Area of remaining portion

= Area of rectangle − Area of circle

$= 4 \times 2 - \pi \times (1)^2 = (8 - \pi)$ cm$^2$.

**63.** **(b)** $r = \sqrt{22^2 + 19^2 + 8^2}$ cm

$= \sqrt{484 + 361 + 64}$ cm

$= \sqrt{909}$ cm = 30 cm

**64.** **(a)** Area of rectangle = $l \times b$

Let, the new width be $b_1$

Then, $l \times b = \frac{4}{3} l \times b_1$

$\therefore \quad b_1 = \frac{3}{4} b = 0.75b$

Thus, there should be a reduction of 25% in the width.

**65.** **(d)** Area of rectangle = 6.4 × 2.5 = 16 $m^2$

According to question:

Area of square = Area of the rectangle

$\therefore$ Area of square = 16 $m^2$

$\therefore$ Side of the square = 4 m.

**66.** **(d)** $\pi \times 5 \times 5 - \pi \times 4 \times 4$

$= 25\pi - 16\pi = 9\pi$ cm$^2$.

**67.** **(b)** The length of the room = 4 m

Since it can be partitioned into two equal square rooms, the two equal parts can only be of 2 m each.

**68.** **(c)** Let length = $a$ m and breadth = $b$ m

Then, $2(a + b) = 46$

or, $a + b = 23$ and $ab = 120$

$\therefore$ Diagonal $= \sqrt{a^2 + b^2} = \sqrt{(a+b)^2 - 2ab}$

$= \sqrt{(23)^2 - 2 \times 120} = \sqrt{289}$ = 17 m.

**69.** **(c)** Perimeter of the square = 4 × 22 m = 88 m

$2\pi r = 88$ m

$\Rightarrow \quad r = 88 \times \frac{7}{22 \times 2}$ m = 14 m.

**70.** **(c)** Area of an equilateral $\Delta = \frac{\sqrt{3}}{4} a^2$

$[3a = 132 \;\therefore\; a = 44]$

$= \frac{\sqrt{3}}{4} \times 44 \times 44$

= 838.312 m$^2$.

Area of square = $a^2$ = 33 × 33

$= 1089 \text{ m}^2 \left[a = \frac{132}{4} = 33\right]$

Area of regular hexagon

$= \frac{3\sqrt{3}a^2}{2} = \frac{3\sqrt{3} \times 22 \times 22}{2} . \left[a = \frac{132}{6} = 22\right]$

Area of circle = $\pi r^2$

$= \frac{22}{7} \times 21 \times 21 \left[r = \frac{132}{2\pi} = 21\right]$

$\therefore$ Circle has largest surface area.

**71.** **(c)** Let, $r$ be the radius of smaller circle

Radius of larger circle = $12r$

$\frac{\text{Area of larger circle}}{\text{Area of smaller circle}} = \frac{\pi(12r)^2}{\pi r^2} = \frac{144}{1}$

$\therefore$ Area of large circle contains the area of smaller circle 144 times.

**72.** **(b)** If $a$ be the side of the square and $r$ be the radius of the circle, then,

$2\pi r = 4a$

or, $r = \frac{4a}{2\pi} = \frac{2a}{\pi}$

$\therefore$ Area of the circle = $\pi r^2$ and,

area of the square = $a^2$

$\therefore$ Area of the circle:Area of the square

$= \pi r^2 : a^2$

$= \frac{\pi\left(\frac{2a}{\pi}\right)^2}{a^2} = \frac{\pi \frac{4a^2}{\pi^2}}{a^2}$

$= \frac{4}{\pi} = \frac{4 \times 7}{22}$ = 14:11.

**73.** **(c)** Let, the length and breadth of the plot be $3x$ and $x$ feet, respectively.

Total area of the plot = 4 × 1200 = 4800 ft$^2$.

$\therefore$ $x \times 3x = 4800 \Rightarrow x = 40$ ft

$\therefore$ Length = 3 × 40 = 120 ft.

**74.** **(b)** Ratio of the areas = 4:25

Ratio of the sides = 2:5

If the side of $s_1$ is 2 cm, then side of $s_2$ is 5 cm.

If the side of $s_1$ is 6 cm, the side of $s_2$ is $\frac{5}{2} \times 6 = 15$ cm.

**75.** **(b)** Circumference $= \left(2 \times \frac{22}{7} \times 70\right)$ cm = 440 cm

Distance travelled in 10 revolutions

= 4400 cm = 44 m

$\therefore$ Speed $= \frac{\text{Distance}}{\text{Time}} = \left(\frac{44}{5}\right)$ m/s

$= \left(\frac{44}{5} \times \frac{18}{5}\right)$ Km/h = 31.68 Km/h.

**76.** **(d)** $lb = 60$ m$^2$

$d^2 = l^2 + b^2$

$d + l = 5b \Rightarrow d = 5b - l$

$\therefore$ $d^2 = 25b^2 + l^2 - 10bl$

$\Rightarrow l^2 + b^2 = 25b^2 + l^2 - 10bl$

$\Rightarrow l^2 + b^2 = 25b^2 + l^2 - 10 \times 60$

$\Rightarrow 24b^2 = 600$ or, $b = 5$

$\therefore$ $l = 60 \div 5 = 12$ m.

**77. (b)**

**78. (c)** Distance = $2 \times 3.14 \times 50 \times 10$

$= 3140$ m

12 Km/h = $\frac{10}{3}$ m/s

Time = $\frac{3140}{10/3}$ = 942 second

$= \frac{942}{60}$ minutes

= 15.7 minutes.

**79. (d)** Length of the area to be carpeted = $8 - 0.2$

$= 7.8$ m

Width = $5 - 0.2 = 4.8$ m

$\therefore$ Area to be carpeted = $7.8 \times 4.8$ m$^2$

Total cost = $18 \times 7.8 \times 4.8$ = ₹673.92.

**80. (a)** Let, the length of the big rectangle be $x$ m

$\therefore$ Area of the big rectangle = $x \times 2 = 2x$ m$^2$

$\therefore$ Area of the small rectangle = $\frac{1}{6} \times 2x = \frac{x}{3}$ m$^2$

$\therefore$ Breadth of the small rectangle = $\frac{x}{3} \div x = \frac{1}{3}$ m.

**81. (b)** Let, original radius = $r$

Reduced radius = $r - 0.4r = 0.6r$

$\therefore$ Percentage reduction in circumference

$= \frac{2\pi r - 2\pi(0.6)r}{2\pi r} \times 100 = 40\%$

**82. (d)** Required area = (Area of a square of side $a$)

$+ 4\left(\text{Area of semi-circle of radius } \frac{a}{2}\right)$

$= a^2 + 4 \times \frac{1}{2}\pi \times \left(\frac{1}{2}a\right)^2$

$= a^2 + \frac{\pi a^2}{2}$.

**83. (a)** (Diagonal)$^2$ = $2 \times 6050$ m$^2$ = 12100 m$^2$

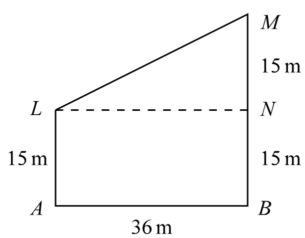
Diagonal = 110 m

Time taken = $\frac{110}{10} \times \frac{1}{2}$ minutes = $5\frac{1}{2}$ minutes.

**84. (b)** Length of each side of hexagon = $r$

$\therefore$ Its perimeter = $6r$.

**85. (b)** Let, $AL$, $BM$ be poles with tops at $L$ and $M$, respectively.




$LA$ = 15 m, $MB$ = 30 m

$AB$ = 36 m.

Let, $LN$ be parallel to the ground

$LN = AB$ = 36 m

and, $MN = 30 - 15 = 15$ m

$\therefore$ $LM = \sqrt{36^2 + 15^2} = \sqrt{1296 + 225} = 39$ m.

**86. (d)** Let, the breadth be $x$ m

$\therefore$ Length = $\frac{4x}{3}$ m

$\therefore$ $\frac{4x}{3} \times x = 300$

or, $x^2 = 300 \times \frac{3}{4} = 225$

$x = \sqrt{225} = 15$ m

and, length = $\frac{4}{3} \times 15 = 20$ m

length − breadth = $20 - 15$ m = 5 m.

**87. (a)** Let, the original length of each side = $a$

Then, area = $\frac{\sqrt{3}}{4}a^2 = A$

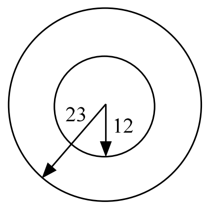
New area = $\frac{\sqrt{3}}{4}\left[\left(\frac{101.5}{100}a^2\right)\right]$

$= \frac{\sqrt{3}}{4}\left(\frac{20.3}{20}\right)a^2 = \frac{20.3}{20}A$

Increase in area = $\left(\frac{0.3}{20}A \times \frac{1}{A} \times 100\right)\%$

= 1.5%

**88. (c)** Shaded area of the two (in between) concentric circle of radius $R$ and $r$ is $\pi(R + r)(R - r)$




$\therefore$ Additional grassy area

$= \frac{22}{7} \times (23 + 12)(23 - 12)$ m$^2$

$= \frac{22}{7} \times 35 \times 11$ m$^2$

= 1210 m$^2$.

**89. (a)** Let, originally, diagonal = $x$

$\therefore$ Original area = $\frac{1}{2}x^2$

After increase, diagonal = $2x$

New area = $\frac{1}{2}(2x)^2$

$\therefore \frac{\text{Original area}}{\text{New area}} = \frac{1}{4}$

$\therefore$ New area = 4 (original area).

**90.** **(c)** If the length of the rectangle is $L$ and its width is $B$, then its perimeter = $2(L + B)$

Increased length = $1.2L$,

Increased width = $1.2B$

Increase perimeter = $2(1.2L + 1.2B)$

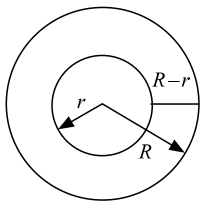
$= 2 \times 1.2(L + B)$

$= 2.4(L + B)$

Increase in perimeter = $0.4(L + B)$

Percentage increase = $\frac{0.4(L+B)}{2(L+B)} \times 100 = 20\%$

**91.** **(b)** $2\pi r - 2\pi r = 44$ m




$\therefore$ $2\pi(r - r) = 44$ m

or, $r - r = 44 \div 2\pi$

$= 44 \div \left(2 \times \frac{22}{7}\right) = 7$ m.

**92.** **(a)** Area of the square-shaped pond = $8 \times 8$

$= 64$ m$^2$

$\therefore$ Area of the field = $8 \times 64 = 512$ m$^2$

If the length of the field be $x$ m.

Then, the breadth of the field = $\frac{x}{2}$ m

$\therefore$ $x \times \frac{x}{2} = 512$

or, $x^2 = 2 \times 512$.

or, $x^2 = 1024$

or, $x = \sqrt{1024} = 32$ m.

**93.** **(b)** $\pi r^2 = 0.49\pi \Rightarrow r = 0.7$ m

Number of revolutions = $\frac{1.76 \times 1000}{2 \times \frac{22}{7} \times 0.7} = 400$.

**94.** **(c)** Radius of the circle = 6 cm

Area of the circle = 36 cm$^2$.

According to question:

Area of the triangle of base 6 cm

= Area of the circle of radius 6 cm

$\therefore$ $\frac{1}{2} \times$ base $\times$ height = 36

$\Rightarrow$ $\frac{1}{2} \times 6 \times$ height = 36

$\Rightarrow$ Height of the triangle = $\frac{36 \times 2}{6} = 12$ cm.

**95.** **(b)** Let, the height of the wall be $h$ metre when the ladder is placed at distance 10 m away from the wall on a stool of 2 m height, it will form a right triangle with sides 10 m, $(h - 2)$ m and taper side of length $h$ m.

Hence, we have $h^2 = 10 + (h - 2)^2$

or, $h^2 - (h - 2)^2 = 100$

$\Rightarrow$ $(h + h - 2) \times (h - h + 2) = 100$

or, $(2h - 2) \times 2 = 100$ or, $4h - 4 = 100$

$\Rightarrow$ $4h - 4 = 100$

$\Rightarrow$ $4h = 104$ or, $h = 26$ m

**96.** **(a)** Let, the side of the square = $x$ cm

Diagonal of the square = $\sqrt{2}\,x$ cm

Area of the square = $x^2$ cm, i.e., $\frac{(\text{Diagonal})^2}{2}$

According to question:

Diagonal of the new square = $2 \times \sqrt{2}\,x$

$= 2\sqrt{2}\,x$ cm

$\therefore$ Area of the new square

$= \frac{(\text{Diagonal of the new square})^2}{2}$

$= \frac{(2\sqrt{2}x)^2}{2} = 4x^2$ cm$^2$.

**97.** **(b)** Area of the circle = 154 cm$^2$

Let, its radius = $r$, then $154 = \frac{22}{7}r^2$

$\Rightarrow$ $r^2 = \frac{154 \times 7}{22} = 49$ or, r = 7 cm

Circumference = $2\pi r = 2 \times \frac{22}{7} \times 7 = 44$ cm

Length of arc = $\frac{44 \times 45}{360} = 5.5$ cm.

**98.** **(b)** Let, the base be $2x$ m and height $3x$ m.

Then, $\frac{1}{2}(2x \times 3x) = \frac{1}{12} \times 10000$

[$\because$ 1 hectare = 10000 m$^2$]

or, $x = \sqrt{\frac{10000 \times 2}{6 \times 12}} = \frac{100}{6} = \frac{50}{3}$

$\therefore$ Base = $2 \times \frac{50}{3} = 33\frac{1}{3}$ m

Height = $\frac{3 \times 50}{3} = 50$ m.

**99.** **(b)** Length of the longer side = $\frac{1200}{30} = 40$ m

and the length of the diagonal = $\sqrt{30^2 + 40^2} = 50$ m

$\therefore$ Length of the fence = 30 + 40 + 50 = 120 m

$\therefore$ The job cost = 120 × 10 = ₹1200.

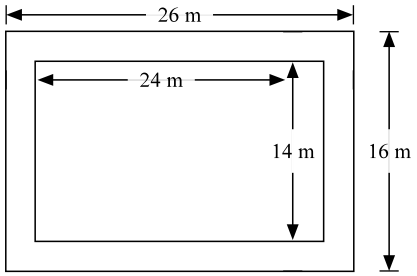
**100.** **(d)** $\pi d - d = 105 \Rightarrow (\pi - 1)d = 105$

$$\Rightarrow \left(\frac{22}{7}-1\right)d = 105$$

$$\therefore\ d = 105 \times \frac{7}{15} = 49 \text{ cm.}$$

**101.** **(c)** Area of garden = 24 × 14 = 336 m$^2$

Area of the (garden + path) = 26 × 16 = 416 m$^2$




$\therefore$ Area of the path = 416 − 336 = 80 m$^2$

Area of 1 tile = 20 × 20 = 400 cm$^2$ = 0.04 m$^2$

$$\therefore\ \text{Number of tiles required} = \frac{80}{0.04} = 2000.$$

**102.** **(b)** Let, one diagonal = $x$ cm

Then, another diagonal

$$= \left(\frac{80}{100}x\right) \text{ cm} = \left(\frac{4}{5}x\right) \text{ cm}$$

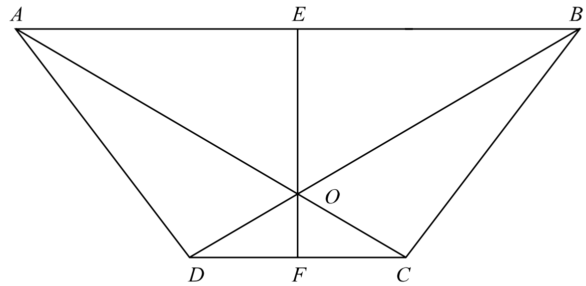
$$\text{Area of rhombus} = \frac{1}{2}x\times\frac{4}{5}x=\frac{2}{5}x^2$$

$$= \frac{2}{5} \times \text{(square of longer diagonal).}$$

**103.** **(d)** $\Delta OAB = \frac{1}{2} \times AB \times OE$

$$= \frac{1}{2} \times 2CD \times OE$$

$$= CD \times OE$$




$$\Delta OCD = \frac{1}{2} \times CD \times OF$$

$$\therefore\ \frac{\Delta AOB}{\Delta COD} = \frac{CD\times OE}{\frac{1}{2}\times CD\times OF} = \frac{CD\times 2\times OF}{\frac{1}{2}\times CD\times OF} = \frac{4}{1}$$

= 4:1.

**104.** **(c)** Ratio of the areas of similar triangles

= Ratio of the squares of corresponding sides

$$= \frac{(3x)^2}{4x^2} = \frac{9x^2}{16x^2} = \frac{9}{16} = 9:16.$$

**105.** **(c)** $\frac{1}{2} \times 24 \times h = \frac{\sqrt{3}}{4} \times 24 \times 24$

or, $h = 12\sqrt{3}$

$\therefore\ 3r = 12\sqrt{3} \Rightarrow r = 4\sqrt{3}$ cm

Area of the circle = $\pi \times (4\sqrt{3})^2$ cm$^2$ = $48\pi$ cm$^2$.

**106.** (b) $r = 0.14$

Number of revolutions

$$= \left(\frac{0.66\times1000}{2}\times\frac{7}{22}\times\frac{1}{0.14}\right) = 750.$$

## Exercise-2
## (Based on Memory)

**1.** **(e)** Perimeter $=\dfrac{2(8+5)}{(8-5)}\times 60 = 520$ m

**2.** **(d)** Let, the length and breadth of the plot be $6x$ m and $5x$ m respectively.

$\therefore\ 6x - 5x = 34$

$\therefore\ x = 34$

Length = $6x$ = 204

Breadth = $5x$ = 170

$\therefore$ Perimeter of the plot

= 2(204 + 170) = 748 m

**3.** **(e)** $(4x)(3x) = 1728$

$\Rightarrow x^2 = 144 \qquad \therefore\ x = 12$

$\Rightarrow$ Length = 48; Breadth = 36

$$\therefore\ \text{Required ratio} = \frac{36}{36\times 48} = 1:48$$

**4.** **(a)** Area of path $= \pi[(4.5)^2 - 4^2]$

$= 3.14[8.5\times 0.5] = 13.35$ cm$^2$

**5.** **(c)** Radius $= \dfrac{88}{2\pi} = \dfrac{88 \times 7}{2 \times 22} = 14$ cm

Area $= = \dfrac{22}{7}(14)^2 = 616 \text{ cm}^2$

**6.** **(c)** $2\pi r = 396$ is $r = \dfrac{396 \times 7}{2 \times 22} = 63$

$\therefore$ Area $= \pi r^2 = \dfrac{22}{7} \times 63 \times 63 = 12474 \text{ m}^2$

**8.** **(e)** Let, the breadth of the rectangle is $x$ metres. Then we have,

$x \times 3x = 12$

$\therefore$ $x = 2$ m [Breadth]

and, $3x = 6$ m [Length]

Thus the required perimeter

$= 2(6 + 2) = 16$ m

**9.** **(c)** We have, $\pi r^2 = 7 \times 2\pi r$

$\therefore$ $r = 14$

$\therefore$ Circumference $= 2\pi r = 2 \times \dfrac{22}{7} \times 14 = 88$

**10.** **(a)** Let, the length of the rectangular filed be $x$ m.

$\therefore$ Width of the rectangular field

$= (x - 48)$ m

$2[x + (x - 48)] = 160$

$\Rightarrow$ $4x - 96 = 160$ $\Rightarrow x = 64$

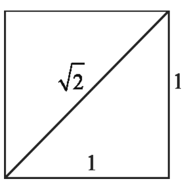
$\therefore$ Area of the rectangular field

$= 64 \times 16 = 1024 \text{ m}^2$

Area of the square field = Area of the rectangular field $= 1024 \text{ m}^2$

$\Rightarrow$ Side of the square field $= \sqrt{1024} = 32$ m

**11.** **(b)**




Required ratio $= (1)^2 : (\sqrt{2})^2 = 1 : 2$

**12.** **(a)** Perimeter $= 2(3x + 2x)$

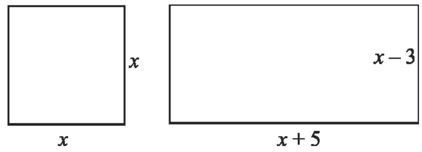
$= 10x = 20$ (Given)

$\Rightarrow$ $x = 2$

$\therefore$ Length = 6, Breadth = 4

$\Rightarrow$ Area of the rectangle = 24 cm$^2$

**13.** **(c)**




Given: $(x + 5)(x - 3) = x^2$

$\Rightarrow$ $x^2 + 2x - 15 = x^2 \Rightarrow x = \dfrac{15}{2}$

$\therefore$ Length of the rectangle $= \dfrac{15}{2} + 5 = \dfrac{25}{2}$

Breadth of the rectangle $= \dfrac{15}{2} - 5 = \dfrac{5}{2}$

$\therefore$ Perimeter of the rectangle

$= 2\left(\dfrac{25}{2} + \dfrac{5}{2}\right) = 30$ cm

**14.** **(c)** Area of the square $= 8 \times 8 = 64 \text{ cm}^2$

$\therefore$ Area of the rectangle = 64 cm$^2$

$\therefore$ $L \times B = 64$ cm$^2$

$\therefore$ Length of the rectangle may be 16 times or 32 times of the breadth.

**15.** **(c)** Area of the $\Delta = \dfrac{1}{2} \times AE \times BC$

$= \dfrac{1}{2} \times 2 \times AE \times BE$ (Because BE $= \dfrac{1}{2}$ BC)

= AE × BE

$= (AD + DE) \times \sqrt{BD^2 - DE^2}$

$= (r + DE) \times \sqrt{(r^2 - DE^2)}$

$= (r + DE) \times (r - DE)^{1/2}(r + DE)^{1/2}$

$= (r + DE)^{3/2} \cdot (r - DE)^{1/2}$

**16.** **(a)** Let, the radius of the circle and the height of the right angled $\Delta$ be $r$ and $h$ respectively.

$\therefore$ $r = \dfrac{(100 + 20)}{100} h$

and, area of $\Delta = \dfrac{1}{2} \times h \times 36 = 18h$

$\therefore$ Area of the circle = $18h$

$\because$ $\pi r^2 = 18h$

$\Rightarrow$ $\dfrac{22}{7} r^2 = \dfrac{18 \times 100 \times r}{120}$

$\therefore$ $r = \dfrac{18 \times 100 \times 7}{120 \times 22} = 4.77$

$\therefore$ Area of the circle $= \dfrac{22}{7} r^2 = \dfrac{22}{7} \times 4.77 \times 4.77$

= 72 cm$^2$ (App.)

**17.** **(a)** Let, the ratio of their bases is $x:y$

$\therefore \quad \frac{x}{y}\times\frac{3}{4}=\frac{4}{3}$

or $\frac{x}{y}=\frac{4}{3}\times\frac{4}{3}=\frac{16}{9}$

Hence, required ratio = 16:9.

**18.** **(d)** One side of the rhombus

$= \sqrt{\left(\frac{24}{2}\right)^2+\left(\frac{10}{2}\right)^2}$ = 13 cm

Hence, perimeter = 13 × 4 = 52 cm.

**19.** **(a)** Length of the longest rod

$= \sqrt{10^2+6^2+4^2}=2\sqrt{38}$ m.

**20.** **(b)** Length of the wire = 4 × $\sqrt{81}$ = 36 m

Perimeter of semi-circle = 36 m

or, $\pi r + 2r = 36$

or, $r(\pi + 2) = 36$

or, $r = \frac{36}{\pi+2}=\frac{36}{\frac{22}{7}+2}$ = 7 m

Therefore, area of the semi-circle = $\frac{1}{2}\pi r^2$

$= \frac{1}{2}\times\frac{22}{7}\times 7\times 7 = 77\text{ cm}^2$.

**21.** **(b)** Required perimeter = $\sqrt{\left(\frac{24}{4}\right)^2+\left(\frac{32}{4}\right)^2}\times 4$

= 40.

**22.** **(a)** Length of the diagonal = $(\sqrt{12\times5})\times\sqrt{2}$

$= 2\sqrt{30}$ m.

**23.** **(b)** Required height = $\frac{2\times15\times12}{20}$

= 18 cm.

**24.** **(a)** Perimeter of rhombus = 4 × $\sqrt{12^2+16^2}$

= 80 cm.

**25.** **(c)** Enclosed area = $\left(\frac{\sqrt{484}\times4}{2\pi}\right)^2\times\pi$

= 616 cm$^2$.

**26.** **(b)** Area of the square = 144 cm$^2$

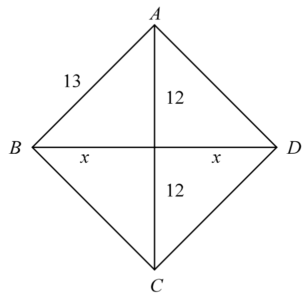
Area of the rectangle = 140 cm$^2$

Length of the rectangle = 14 cm

⇒ Width of the rectangle = 10 cm

∴ Perimeter of the rectangle = 48 cm.

**27.** **(c)** $x = \sqrt{13^2-12^2} = 5$




∴ The diagonals of the rhombus are 10 and 24.

∴ Area of the rhombus = $\frac{1}{2}$ × 10 × 24

= 120 cm$^2$.

**28.** **(b)** Let, the sides of the rectangle be $6K$ and $5K$, respectively.

$\therefore\ 2[6K + 5K] = 2\times\frac{22}{7}\times 21 = 132 \Rightarrow K = 6$

∴ Area of the rectangle = $30K^2$ = 1080 cm$^2$.

**29.** **(b)** Breadth of the rectangle = $\frac{48}{3}$ = 16 m

Perimeter of the rectangle = $2(l + b)$ = 2 × 64 = 128 m

Side of the square = $\frac{48}{3}$ = 32

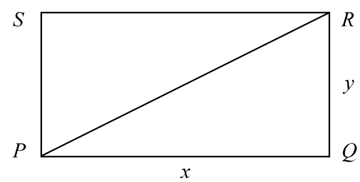
Area of the square = $(32)^2$ = 1024 m$^2$.

**30.** **(a)** Side of the equilateral triangle

$= \sqrt{\frac{4}{\sqrt{3}}\times400\sqrt{3}}=\sqrt{1600}$ = 40 m

Perimeter = 40 × 3 = 120 m.

**31.** **(d)** Length of $PR$ = 52 × $\frac{15}{60}$ = 13 m




$PQ + RQ = 68\times\frac{15}{60}$ = 17 m

i.e., $x + y = 17$ and $x^2 + y^2 = 169$

Solving the above two, we get

$x = 12$ and $y = 5$

Area = 12 × 5 = 60 m$^2$.

**32.** **(b)** Circumference of wheel = $2\pi r$

$= 2\times\frac{22}{7}\times\frac{3}{2}=\frac{66}{7}$ m

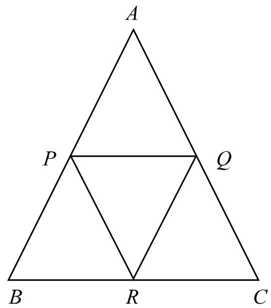
Wheel will take = $\frac{5280\times7}{28\times66}$ = 20 m.

**33.** **(c)** *ABC* is a triangle. *PQR* is the triangle which is formed with the mid-points of the $\Delta ABC$. First of all, find the area of the $\Delta ABC$

$s = \dfrac{a+b+c}{2} = \dfrac{3+4+5}{2} = \dfrac{12}{2} = 6$ cm

Area $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{6\times 3\times 2\times 1} = 6$ cm$^2$

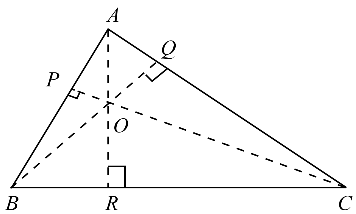



$\therefore$ $(\Delta PQR) = \dfrac{1}{4}$ of $(\Delta ABC) = \dfrac{1}{4} \times 6 = \dfrac{3}{2}$ cm$^2$.

**34.** **(c)** In $\Delta ABC$, $O$ is the point from where three perpendicualar lines are drawn. And, also $OP = \sqrt{3}$ cm, $OQ = 2\sqrt{3}$ cm and $OR = 5\sqrt{3}$ cm

Area of $\Delta AOB = \dfrac{1}{2} \times OP \times AB$

Area of $\Delta AOC = \dfrac{1}{2} \times OQ \times AC$




Area of $\Delta OBC = \dfrac{1}{2} \times OR \times BC$

$\dfrac{1}{2} \times \sqrt{3} \times x + \dfrac{1}{2} \times 2\sqrt{3} \times x + \dfrac{1}{2} \times 5\sqrt{3} \times x$

$= \dfrac{\sqrt{3}}{4} x^2$

[$x$ = Length of the side]

or, $\dfrac{\sqrt{3}+2\sqrt{3}+5\sqrt{3}}{2} = \dfrac{\sqrt{3}}{4} x$

or, $\dfrac{8\sqrt{3}}{2} = \dfrac{\sqrt{3}x}{4}$

or, $x = 16$ cm

$\therefore$ Perimeter of the triangle $= 3x = 3 \times 16 = 48$ cm.

**35.** **(b)** We know that 1 decametre = 10 m

$\therefore$ 2 Km + 26 decametre $= 2 \times 1000 + 26 \times 10$

$= 2260$ m

Also, 113 revolutions = 2260 m

$\therefore$ 1 revolution $= \dfrac{2260}{113} = 20$ m

$\therefore$ diameter of wheel $= \dfrac{20\times 7}{22} = \dfrac{70}{11} = 6\dfrac{4}{11}$ m.

**36.** **(b)** Let, the side of one of the squares be $x$ cm. Then, side of longer square $= (x + 2)$ cm

Now, $(x + 2)^2 - x^2 = 32$

or, $x^2 + 4x + 4 - x^2 = 32$

or, $4x = 28$

or, $x = 7$ cm

Length of the side of the longer square $= 7 + 2 = 9$ cm.

**37.** **(a)** Side of the two squares are $\dfrac{40}{4} = 10$ cm and $\dfrac{32}{4} = 8$ cm

Let, the side of the third square be '$x$' cm

Then, $x^2 = 10^2 - 8^2 = 100 - 64 = 36$

or, $x = 6$ cm

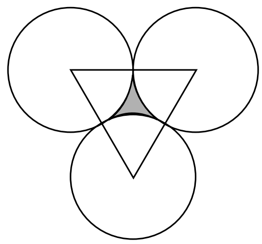
$\therefore$ Perimeter of the third square $= 6 \times 4 = 24$ cm.

**38.** **(c)** Side of the rhombus $= \dfrac{40}{4} = 10$ cm

Length of the other diagonal $= 2\sqrt{10^2 - 6^2}$

$= 2\sqrt{100-36} = 2 \times 8 = 16$ cm.

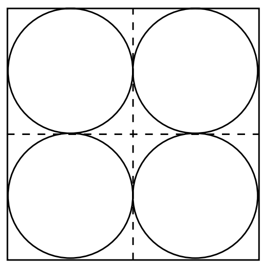
**39.** **(b)** Required Area $= \dfrac{1}{2} \times \dfrac{\sqrt{3}}{2} \times 7 \times 7 - \dfrac{22}{7} \times 3.5 \times \dfrac{3.5}{2}$



$= 3.5 \times 3.5\left(\sqrt{3} - \dfrac{11}{7}\right) = 12.25 \times 0.1605 = 1.967$ cm$^2$.

**40.** **(b)** Side of square $= \sqrt{784} = 28$ cm

Radius of each plate = 7 cm



$\therefore$ Circumferencee $= 2 \times \dfrac{22}{7} \times 7 = 44$ cm.

**41.** **(d)** Let, the base and height of the triangle, and length and breadth of the rectangle be $L$ and $h$ and $L_1$ and $b_1$, respectively.

Then, $\frac{1}{2} \times L \times h = \frac{2}{3} \times L_1 \times b_1$ ...(1)

$L = \frac{4}{5} b_1$ (2) and $L_1 + b_1 = 100$ ...(3)

In the above we have three equations and four unknowns. Hence, the value of '$h$' cannot be determined.

**42.** **(b)** Let the length and breadth of the rectangle be $l$ and $b$, respectively.

Then, $2(4l + b) = 480$

$\therefore$ $4l + b = 240$ ...(1)

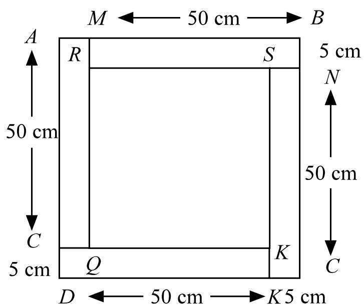
and, $4lb = 12800$

$\therefore$ $lb = 3200$ ...(2)

Solving equations (1) and (2), we get

$l = 40$ m or, $l = 80$ m.

**43.** **(e)** The four sheets are *BMRN*, *AMQL*, *NSKC* and DLPK.




$\therefore$ Side of the new square sheet = 50 + 5 = 55 cm and the side of the inner part of the square = 55 − 10 = 45 cm

Hence, area = $(45)^2 = 2025$ cm$^2$.

**44.** **(e)** Let, the side of the square be $x$ m

$\therefore$ Perimeter of the square = $48 \times 5 = 4x$

$\therefore$ $x = 60$ m

$\therefore$ Area = $(60)^2 = 3600$ m$^2$.

**45.** **(b)** Area of semi-circle = $\frac{1}{2}\pi r^2 = \frac{1}{2} \times \frac{22}{7} \times 7 \times 7 = 77$ m$^2$.

**46.** **(e)** Let, the length of the rectangular field be '$x$' m. Then, length of the field will be

$x + \frac{x \times 15}{100} = \frac{23x}{20}$

Now, $x \times \frac{23x}{20} = 460$

or, $23x^2 = 460 \times 20$

or, $x^2 = 20 \times 20$ or, $x = 20$ m.

**47.** **(c)** Let, the length of the rectangular hall be '$x$' m, then the breadth of the rectangular hall = $\frac{2x}{3}$ m

Area = $\frac{2x}{3} \times x = \frac{2x^2}{3}$

or, $\frac{2x^2}{3} = 2400$ or, $x = 60$ m.

**48.** **(c)** Suppose the back wheel has made $x$ revolutions.

$\therefore$ Front wheel has made $(10 + x)$ revolutions.

$\Rightarrow$ $3\pi x = 2\pi\,(10 + x)$

$\Rightarrow$ $\pi x = 2\pi \times 10 \Rightarrow x = 20$

$\therefore$ The wagon has travelled $3\pi x = 60\pi$.

**49.** **(c)** $\pi r2 = 9\pi$, where $r$ is the radius of the circle

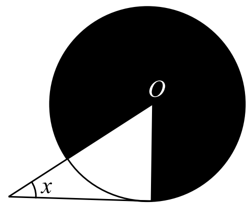
$\Rightarrow r = 3$, $2r$ = diameter = 6,

Circumference = $2\pi r = 6\pi$.

**50.** **(d)** Area of the circle = $\pi r2 = 16\pi$ $(\because r = 4)$

$\therefore$ 360° covers an area of $16\pi$

1° covers an area of $\frac{16\pi}{360°} = 8$




$\left(\frac{\pi}{2} - x\right)^\circ$ [unshaded region] covers an area of $8\left(\frac{\pi}{2} - x\right)$,

i.e., $4\pi - 8x$.

Area of the shaded region = $14\pi$

$\therefore$ Area of the unshaded = $2\pi$

$\therefore$ $4\pi - 8x = 2\pi \Rightarrow 8x = 2\pi \Rightarrow x = \frac{\pi}{4} = 45°$.

**51.** **(a)** Let, the area of the circle be $A = \pi r^2$, where $r$ is the radius. If $r$ is increased to $r$ + 8% of $r$,

i.e., $\frac{27r}{25}$, therefore area becomes

$\pi \times \left(\frac{27}{25}r\right)^2 = \pi \times \frac{729}{625}r^2$

$\therefore$ Increase in area = $\frac{104}{625}\pi r^2$

$\Rightarrow$ Per cent increase in area

$= \frac{104}{625} \times 100 = 16.64$.

**52.** **(a)** Perimeter of square = $2 \times 2\ (8 + 7) = 60$ cm

$4a = 60$ cm

$\therefore$ $a = 15$ cm

Diameter of circle = 15 cm

$\therefore$ Radius = 7.5 cm

Circumference of semicircle = $\pi r + 2r = \frac{22}{7} \times 7.5 + 2 \times 7.5$

= 38.57 cm

**53.** **(d)** Area of a square = $a^2$ = 1024

$\therefore$ $a = \sqrt{1024} = 32$ cm

Breadth of the rectangle = 12 cm less than the side of the square = 32 − 12 = 20 cm

Length of the rectangle = twice the side of the square = 2 × 32 = 64 cm

Ratio of the length and breadth = 64:20 = 16:5

**54.** **(a)** Rate of the painting = ₹2 per m$^2$

Area of the rectangular floor

$= \frac{256}{2} = 128$ m$^2$

Let, the breadth of rectangular floor is $x$ m.

Length = $2x$ m

Area of the rectangular floor = $l \times b$

$128 = 2x \times x$

$128 = 2x^2$

$x^2 = \frac{128}{2} = 64$

$x = 8$ m

So, the length of the floor = $2x$ = 2 × 8 = 16 m

**55.** **(b)** Suppose the number is $x$.

$x - \frac{x}{7} = 180$

$\Rightarrow \frac{7x - x}{7} = 180$

$\Rightarrow \frac{6x}{7} = 180$

$\Rightarrow x = \frac{180 \times 7}{6}$

$x = 210$

**56.** **(a)** Let, the length and breadth of a floor be $32x$ and $21x$, respectively.

Given perimeter of the floor = 212 feet

$2(32x + 21x)$ = 212 feet

$\Rightarrow$ $106x$ = 212 feed

$\Rightarrow$ $x = \frac{212}{106}$ = 2 feet

$\therefore$ Area of the floor = Length × Breadth

= (32 × 2) × (21 × 2)

= 64 × 42

= 2688 square feet

Hence, cost of laying carpet = 2688 × 2.5 = ₹6720

**57.** **(d)** $2\pi r = 88$

$\therefore$ $r = \frac{88 \times 7}{44} = 14$ m

$\therefore$ Area = $\pi r^2$

$= \frac{22}{7} \times 14 \times 14 = 616$ m$^2$

$2\pi r_1 = 220$

$r_1 = \frac{220 \times 7}{2 \times 22} = 35$ m

$\therefore$ Area = $\pi r_1^2 = \frac{22}{7} \times 35 \times 35 = 3850$ m$^2$

Difference = 3850 − 616 = 3234 m$^2$

**58.** **(c)** Area of the figure = $53 \times 28 + 2 \times \frac{1}{2} \times \frac{22}{7} \times 14 \times 14$

= 2100 cm$^2$

**59.** **(b)** $2(l + b) = 668$

$\therefore$ $l + b = 334$

$\therefore$ $l = (334 - b)$

Length of a rectangle = Twice the diameter of a circle

$334 - b = 2 \times d = 2 \times 2r = 4r$

$\therefore$ $r = \frac{334 - b}{4}$

Area of square = Circumference of circle

$(22)^2 = 2\pi r$

$484 = \frac{2 \times 22(334 - b)}{7 \times 4}$

$\therefore$ $334 - b = \frac{484 \times 7 \times 4}{2 \times 22} = 308$

$\therefore$ $b = 334 - 308 = 26$ cm

**60.** **(a)** Circumference of circular plot

$= \frac{3300}{15} = 220$ m

$\therefore$ $2\pi r = 220$

$r = \frac{220}{2\pi} = \frac{220 \times 7}{2 \times 22} = 35$ m

Area of the plot = $\pi r^2$

$= \frac{22}{7} \times 35 \times 35$

= 3850 m$^2$

Cost of flooring of one square metres plot = ₹100

Cost of flooring of 3850 m$^2$ plot = 3850 × 100

= ₹385000

**61.** **(c)** Breadth of carpet = 3 m

Length of carpet = 3 × 1.44 = 4.32 m

Original cost of carpet = 3 × 4.32 × 45 = ₹583.20

Cost of carpet after increasing of length and breadth

$= 3 \times \frac{125}{100} \times 4.32 \times \frac{140}{100} \times 45$

= 15 × 1.08 × 7 × 9 = ₹1020.60

$\therefore$ Increase (Difference)

= 1020.60 − 583.20 = ₹437.40

**62.** **(c)** Area of square $(a)^2 = 196$

$\therefore\ a = \sqrt{196} = 14$ cm

Radius of a circle $= 14 \times 2 = 28$ cm

$\therefore$ Circumference $= \frac{22}{7} \times 2 \times 28 = 176$ cm

Now according to the question $b = 176$ cm

Also, $2(l + b) = 712$

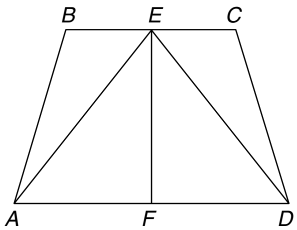
$2(l + 176) = 712$

$l + 176 = 356$

$\therefore\ l = 356 - 176$

$\therefore\ l = 180$ cm

**63.** (d)




$EF$ is the perpendicular on side $AD$.

$\therefore$ Area of trapezium $= \frac{1}{2}(AD + BC) \times EF$

Area of $\Delta AED = \frac{1}{2} \times AD \times EF$

$\therefore$ Required ratio $= \dfrac{\frac{1}{2}(AD+BC)\times EF}{\frac{1}{2}\times AD \times EF} = \dfrac{AD+BC}{AD}$

**64.** **(a)** In-radius $= \frac{a}{2\sqrt{3}} = \frac{24}{2\sqrt{3}} = 4\sqrt{3}$ cm

Area of an equilateral triangle $= \frac{\sqrt{3}}{4} \times (\text{side})^2$

$= \frac{\sqrt{3}}{4} \times 24 \times 24$

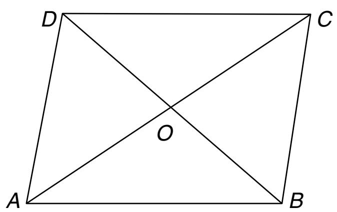
$= 144\sqrt{3}\ \text{cm}^2 = 144 \times 1.732 = 249.408\ \text{cm}^2$

Area of circle $= \pi r^2 = \frac{22}{7} \times 4\sqrt{3} \times 4\sqrt{3} = \frac{1056}{7}$

$= 150.86\ \text{cm}^2$

Area of the remaining part $= (249.408 - 150.86)\ \text{cm}^2$
$= 98.548\ \text{cm}^2 = 98.55\ \text{cm}^2$

**65.** **(c)**




Side of a rhombus $= \frac{2p}{4} = \frac{p}{4}$ units

Let $OA = OC = y$ units

$\therefore\ AC = 2y$ units

Let $OB = OD = x$ units

$\therefore\ BD = 2x$ units

From $\Delta OAB$, $\angle AOB = 90°$

$AB^2 = OA^2 + OB^2$

$\Rightarrow \frac{p^2}{4} = x^2 + y^2$

$\Rightarrow p^2 = 4x^2 + 4y^2$ ...(1)

According to the question, $2x + 2y = m$.

On squaring both sides, we have, $4x^2 + 4y^2 + 8xy = m^2$

$\Rightarrow p^2 + 8xy = m^2 \Rightarrow 8xy = m^2 - p^2$

$\Rightarrow 4xy = \frac{1}{2}(m^2 - p^2)$

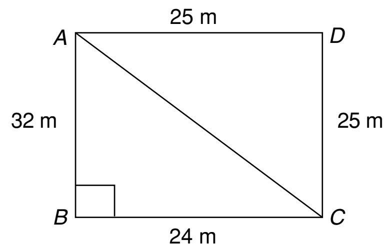
$\therefore$ Area of the rhombus $= \frac{1}{2} \times AC \times BD$

$= \frac{1}{2} \times 2x \times 2y = \frac{1}{2} \times 4xy$

$= \frac{1}{2} \times \frac{1}{2}(m^2 - p^2)$

$= \frac{1}{4}(m^2 - p^2)$ sq units

**66.** **(d)**




$AC = \sqrt{AB^2 + BC^2} = \sqrt{32^2 + 24^2}$

$= \sqrt{1024 + 576} = \sqrt{1600} = 40$ metres

$\therefore$ Area of $\Delta ABC = \frac{1}{2} \times BC \times AB$

$= \frac{1}{2} \times 24 \times 32 = 384\ \text{m}^2$

Semi-perimeter $(s)$ of $\Delta ADC$

$= \frac{25 + 25 + 40}{2} = \frac{90}{2} = 45$ m

$\therefore$ Area of $\Delta ADC = \sqrt{s(s-a)(s-b)(s-c)}$

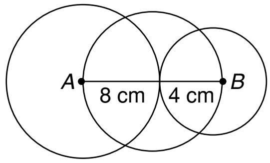
$= \sqrt{45(45-25)(45-25)(45-40)}$

$= \sqrt{45 \times 20 \times 20 \times 5} = (20 \times 15)$

$= 300\ \text{m}^2$

$\therefore$ Area of the plot $= (384 + 300) = 684\ \text{m}^2$

**67.** **(a)**



Diameter = AB (8 + 4) = 12 units

$\text{Radius} = \frac{12}{2} = 6$ units

$\therefore$ Area of circle = $\pi r^2 = \pi \times 6^2 = 36\pi$ sq. units

**68.** **(a)** $\frac{1}{12}\text{ hectare} = \frac{1}{12} \times 10000 \text{ m}^2$

$= \frac{2500}{3} \text{ m}^2$

$\therefore \quad 3x \times 4x = \frac{2500}{3}$

$\Rightarrow \quad x^2 = \frac{2500}{3 \times 3 \times 4} \quad \Rightarrow \quad x = \frac{50}{6}$

$\Rightarrow \quad \text{Width} = 3x = \left(3 \times \frac{50}{6}\right) = 25 \text{ m}$

**69.** **(a)** Let, the side of a square be $x$ cm.

Now, according to the question,

Area of rectangle = 3 × area of square

$\Rightarrow \quad 20 \times \frac{3}{2} x = 3 \times x^2$

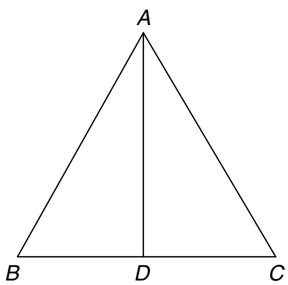
$\Rightarrow \quad x = \frac{20 \times 3}{2 \times 3} = 10 \text{ cm}$

**70.** **(c)** Side of the rhombus $= \sqrt{6^2 + 8^2} = 10 \text{ cm}$

**71.** **(d)** Distance covered by the wheel in one revolution $= \pi d = \frac{22}{7} \times 7 = 22 \text{ m}$

$\therefore \quad \text{Number of revolutions} = \frac{22 \times 1000}{22} = 1000$

**72.** **(b)**




$\frac{\sqrt{3}}{4} \times \text{side}^2 = 9\sqrt{3}$

$\Rightarrow \quad \text{Side}^2 = 9 \times 4 = 36 \quad \Leftrightarrow \quad \text{Side} = \sqrt{36} = 6 \text{ m}$

$\therefore \quad BD = 3$ m

$AD = \sqrt{AB^2 - BD^2} = \sqrt{6^2 - 3^2}$

$= \sqrt{36 - 9} = \sqrt{27} = 3\sqrt{3} \text{ m}$

**73.** **(d)** Area of the floor = 8 × 6 = 48 m$^2$ = 4800 dm$^2$

Area of a square tile = 4 × 4 = 16 m$^2$

$\therefore \quad \text{Number of tiles} = \frac{4800}{16} = 300$

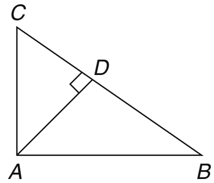
**74.** **(b)** Circum-radius $= \frac{\text{Side}}{\sqrt{3}}$

$\therefore$ Area of circumcircle $= \pi \times \frac{\text{Side}^2}{3} = 3\pi$

$\Rightarrow \quad \text{Side}^2 = 9 \quad \Rightarrow \quad \text{Side} = 3$ cm

$\therefore$ Perimeter of the triangle = 3 × 3 = 9 cm

**75.** **(c)**




$\angle BAC = 90°$ and $\angle ADC = 90°$

$BC = 8$ cm and $AC = 6$ cm

$\therefore \quad AB = \sqrt{8^2 - 6^2} = \sqrt{14 \times 2} = 2\sqrt{7} \text{ cm}$

$\therefore \quad \text{Area or } \Delta ABC = \frac{1}{2} \times BC \times AD = \frac{1}{2} \times AB \times AC$

$\Leftrightarrow \quad 8 \times AD = 2\sqrt{7} \times 6$

$\therefore \quad AD = \frac{3\sqrt{7}}{2} \text{ cm}$

$CD = \sqrt{6^2 - \left(\frac{3\sqrt{7}}{2}\right)^2} = \sqrt{36 - \frac{63}{4}} = \sqrt{\frac{144 - 63}{4}}$

$= \sqrt{\frac{81}{4}} = \frac{9}{2} \text{ cm}$

$\therefore \quad \frac{\Delta ABC}{\Delta ACD} = \frac{AB \times AC}{CD \times AD} = \frac{2\sqrt{7} \times 6}{\frac{9}{2} \times \frac{3\sqrt{7}}{2}} = \frac{2\sqrt{7} \times 6 \times 4}{9 \times 3 \times \sqrt{7}} = 16:9$

**76.** **(d)** Ratio of the sides of triangle $= \frac{1}{4}:\frac{1}{6}:\frac{1}{8}$

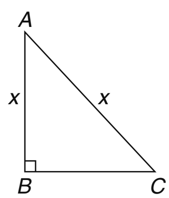
$= \frac{1}{4} \times 24 : \frac{1}{6} \times 24 : \frac{1}{8} \times 24 = 6:4:3$

$[\because \quad \text{LCM of } 4,\ 6,\ 8 = 24]$

$\therefore \quad 6x + 4x + 3x = 91 \quad \Leftrightarrow \quad 13x = 91 \quad \Leftrightarrow \quad x = \frac{91}{13} = 7$

$\Rightarrow$ Required difference = $6x - 3x = 3x = 3 \times 7 = 21$ cm

**77.** **(b)**




$AB = BC = x \text{ cm}, AC = \sqrt{2}x \text{ cm}$

$\therefore \quad 2x + \sqrt{2}x = 2p$

$\Rightarrow \quad x(2 + \sqrt{2}) = 2p \quad \Rightarrow \quad x = \frac{2p}{2 + \sqrt{2}}$

$$= \frac{2p}{2+\sqrt{2}} \times \frac{2-\sqrt{2}}{2-\sqrt{2}} = \frac{2p(2-\sqrt{2})}{4-2} = p(2-\sqrt{2})$$

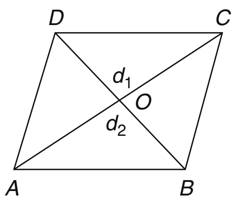
$\therefore$ Area of $\Delta ABC = \frac{1}{2} \times AB \times BC$

$$= \frac{1}{2}x^2 = \frac{1}{2}p^2(2-\sqrt{2})^2 = \frac{1}{2} \times p^2(4+2-4\sqrt{2})$$

$$= (3-2\sqrt{2})p^2 \text{ cm}^2$$

**78.** **(a)** $\pi r_1^2 : \pi r_2^2 = 4:7 \Rightarrow r_1 : r_2 = \sqrt{4}:\sqrt{7} = 2:\sqrt{7}$

**79.** **(d)**




Side of the rhombus $= \frac{20}{4} = 5$ cm and $OB$ = 4 cm

$\therefore QA = \sqrt{5^2 - 4^2} = \sqrt{9} = 3$ cm

$\therefore AC = 6$ cm

Area of the rhombus $= \frac{1}{2} \times d_1 \times d_2 = \frac{1}{2} \times 8 \times 6 = 24$ cm$^2$

**80.** **(b)** Semi-perimeter of triangle($s$) $= \frac{50+78+112}{2}$

$$= \frac{240}{2} = 120 \text{ cm}$$

$\therefore$ Area of triangle $= \sqrt{s(s-a)(s-b)(s-c)}$

$$= \sqrt{120(120-50)(120-78)(120-112)}$$

$$= \sqrt{120 \times 70 \times 42 \times 8} = 1680 \text{ cm}^2$$

$\therefore$ The altitude will be smallest when the base is largest.

$\therefore \frac{1}{2} \times 112 \times h = 1680$

$\Rightarrow h = \left(\frac{1680 \times 2}{112}\right) = 30$ cm

**81.** **(b)** $AB + BC = 12$

$BC + CA = 14$

$CA + AB = 18$

$\therefore 2(AB + BC + CA) = 12 + 14 + 18 = 44$

$\Rightarrow AB + BC + CA = 22$

Now, according to the question,

$2\pi r = 22$

$\Rightarrow 2 \times \frac{22}{7} \times r = 22$

$\Rightarrow r = \frac{7}{2}$ cm

**82.** **(a)** Area of rectangular field $= \frac{1000}{\frac{1}{4}}$

= 4000 m$^2$

$\therefore$ Length $= \left(\frac{4000}{50}\right) = 80$ m

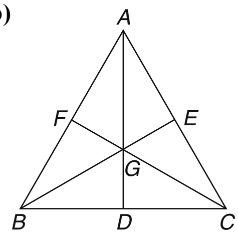
New length of field = (80 + 20) = 100 m

Area = (100 × 50) = 5000 m$^2$

$\therefore$ Required expenditure

$= ₹\left(5000 \times \frac{1}{4}\right) = ₹1250$

**83.** **(b)**




$BG = \frac{2}{3} \times 12 = 8$ cm

$GC = \frac{2}{3} \times 15 = 10$ cm

$AG = \frac{2}{3} \times 9 = 6$ cm

Let, $AF$ be $x$ cm

Now, $\Delta AGF = \Delta GBF$

$\because$ $CF$ = 15 cm and $CG$ = 10 cm

$\because$ $GF$ = (15 − 10) = 5 cm

Now, from the Hero's formula for the area of triangle, we have

$$\sqrt{\frac{6+5+x}{2}\left(\frac{6+5+x}{2}-6\right)\left(\frac{6+5+x}{2}-x\right)\left(\frac{6+5+x}{2}-5\right)}$$

$$= \sqrt{\frac{8+5+x}{2}\left(\frac{8+5+x}{2}-8\right)\left(\frac{8+5+x}{2}-x\right)\left(\frac{8+5+x}{2}-5\right)}$$

$$\Rightarrow \left(\frac{11+x}{2}\right)\left(\frac{x-1}{2}\right)\left(\frac{11-x}{2}\right)\left(\frac{x+1}{2}\right)$$

$$= \left(\frac{13+x}{2}\right)\left(\frac{x-3}{2}\right)\left(\frac{13-x}{2}\right)\left(\frac{x+3}{2}\right)$$

$\Rightarrow (11 + x)(11 - x)(x - 1)(x + 1)$

$= (13 + x)(13 - x)(x - 3)(x + 3)$

$\Rightarrow (11^2 - x^2)(x^2 - 1) = (13^2 - x^2)(x^2 - 9)$

$\Rightarrow 121x^2 - x^4 - 121 + x^2 = 169x^2 - 169 \times 9 - x^4 + 9x^2$

$\Rightarrow 122x^2 - x^4 - 121 = 178x^2 - 1521 - x^4$

$\Rightarrow 56x^2 = 1400$

$\Rightarrow \quad x^2 = \dfrac{1400}{56} = 25$

$\Rightarrow \quad x = \sqrt{25} = 5$

$\therefore$ Side $AB$ = (2 × 5) = 10 cm

Now, area of the triangle $AGB$

$= \sqrt{\dfrac{6+8+10}{2}\left(\dfrac{6+8+10}{2}-6\right)\left(\dfrac{6+8+10}{2}-8\right)\left(\dfrac{6+8+10}{2}-10\right)}$

$= \sqrt{12(6)(4)(2)} = \sqrt{2\times2\times3\times2\times3\times2\times2\times2}$

$= 2 \times 2 \times 2 \times 3 = 24$ cm$^2$

$\therefore$ Area of the triangle $ABC = 3 \times AGB$

$= (3 \times 24) = 72$ cm$^2$

**84.** **(d)** $2\pi r = 2(18 + 26)$

$\Rightarrow \quad 2 \times \dfrac{22}{7} \times r = 44 \times 2$

$\Rightarrow \quad r = 14$ cm

$\therefore$ Area of circle $= \pi r^2$

$= \dfrac{22}{7} \times 14 \times 14 = 616$ cm$^2$

**85.** **(a)** Let the original radius be $r$ cm

Now, according to the question,

$\pi(r + 1)^2 - \pi r^2 = 22$

$\Rightarrow \quad \pi(r^2 + 2r + 1 - r^2) = 22$

$\Rightarrow \quad 2\pi r + \pi = 22$

$\Rightarrow \quad \dfrac{22}{7}(2r+1) = 22$

$\Rightarrow \quad 2r + 1 = 7$

$\Rightarrow \quad 2r = 6 \quad \Rightarrow \quad r = 3$ cm

**86.** **(d)** Sum of interior angles = $(2n - 4) \times 90°$

Sum of exterior angles = 360°

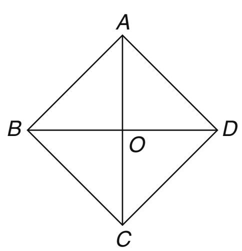
$\therefore \quad (2n - 4) \times 90° = 360° \times 2$

$\Rightarrow \quad 2n - 4 = 2 \times 360° \div 90 = 8$

$\Rightarrow \quad 2n - 4 = 8 \quad \Rightarrow \quad 2n = 12 \quad \Rightarrow \quad n = 6$

**87.** **(a)** $BO = 4$ units; $OC = 3$ units

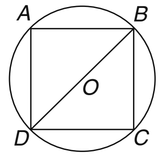
$\angle BOC = 90°$




$\therefore \quad BC = \sqrt{4^2 + 3^2} = 5$ units

$\Rightarrow BC^2 = 25$ sq. units

**88.** **(c)**




$BD$ = Diagonal = 16 cm

Area of square $= \dfrac{1}{2} \times BD^2$

$= \dfrac{1}{2} \times 16 \times 16 = 128$ cm$^2$

**Alternative Method:**

Let, the side of the square be a cm.

$\therefore \quad a^2 + a^2 = 16 \times 16$

$\Rightarrow \quad 2a^2 = 16 \times 16$

$\Rightarrow \quad a^2 = \dfrac{16 \times 16}{2} = 128$

$\Rightarrow$ Area of the square = 128 cm$^2$

**89.** **(c)** Side of the first square $= \sqrt{\text{Area}}$

$= \sqrt{200} = 10\sqrt{2}$ m

Its diagonal $= \sqrt{2} \times$ side

$= 10\sqrt{2} \times \sqrt{2} = 20$ m

$\therefore$ Diagonal of new square $= \sqrt{2} \times 20 = 20\sqrt{2}$ m

$\therefore$ Its area $= \dfrac{1}{2} \times (\text{diagonal})^2$

$= \dfrac{1}{2} \times 20\sqrt{2} \times 20\sqrt{2} = 400$ m$^2$

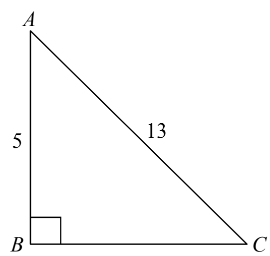
**90.** **(a)** Let, the perpendicular sides of right-angled triangle be $5x$ and $12x$

Now, according to the question, $\dfrac{1}{2} \times 5x \times 12x = 270$

$\Rightarrow \quad 30x^2 = 270$ cm$^2$

$\Rightarrow \quad x^2 = \dfrac{270}{30} = 9$

$\therefore \quad x = 3$




$\therefore$ The length of the hypotenuse

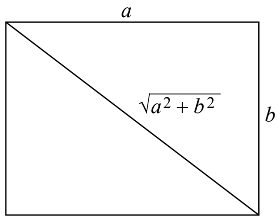
$= \sqrt{(5x)^2 + (12x)^2}$

$= \sqrt{(13x)^2} = 13x = 13 \times 3 = 39$ cm

**91.** **(b)** Let, the length and breadth of the rectangle be $a$ and $b$ respectively.

$a^2 + b^2 = 625 = (\text{diagonal})^2$

$ab = 168 \text{ cm}^2 = \text{area}$




$\because \quad a+b=\sqrt{a^2+b^2+2ab}=\sqrt{625+2\times168}$

$=\sqrt{625+336}=\sqrt{961}=31$ …(1)

and, $a-b=\sqrt{a^2+b^2-2ab}$

$=\sqrt{625-336}=\sqrt{289}=17$ …(2)

Now, on solving equation. (1) and (2), we have

$a=\dfrac{31+17}{2}=24$ and,

$b=\dfrac{31-17}{2}=7$

$\therefore$ Length of the rectangle = 24 cm

**92.** **(b)** Let, the number of men standing in each row be $x$.

Total number when standing in square form = $x^2$

Now, according to the question,

$x^2 + 71 = 6000$

$\Rightarrow \quad x^2 = 5929$

$\therefore \quad x = 77$

**93.** **(a)** Quicker Method:

Required decrease $=\left(\dfrac{x^2}{100}\right)\%=\left(\dfrac{10^2}{100}\right)\%=1\%$

**94.** **(b)** Original area = 6 × 5 = 30

New, area = 7 × 4 = 28

$\therefore$ Required ratio = 30:28

= 15:14 (diminished)

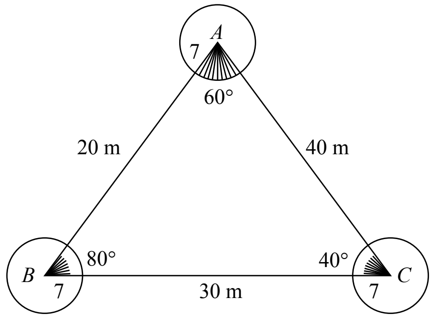
**95.** **(c)** Ratio of triangle's side = 2:3:4

$\therefore$ Ratio of angles = 2:3:4

$\Rightarrow \angle C^\circ=\dfrac{2}{(2+3+4)}\times180^\circ=40^\circ$

$\Rightarrow \angle A^\circ=\dfrac{3}{(2+3+4)}\times180^\circ=60^\circ$

$\Rightarrow \angle B^\circ=\dfrac{4}{(2+3+4)}\times180^\circ=80^\circ$




$\therefore$ Total area of the region of this plot, which can be grazed by the horses = Shaded area

$=\dfrac{40^\circ}{360^\circ}\times\pi r^2+\dfrac{60^\circ}{360^\circ}\times\pi r^2+\dfrac{80^\circ}{360^\circ}\times\pi r^2$

$=\left(\dfrac{40^\circ+60^\circ+80^\circ}{360^\circ}\right)\pi r^2$

$=\dfrac{180^\circ}{360^\circ}\pi r^2=\dfrac{1}{2}\pi r^2=\dfrac{1}{2}\times\dfrac{22}{7}\times7\times7=77 \text{ m}^2$

**96.** **(c)** Area of square = 121 cm$^2$

Side of square = 11 cm

Perimeter of square =(11 × 4) = 44 cm

$\therefore$ Perimeter of square = perimeter of circle

$\therefore$ $2\pi r = 44$ cm

$\Rightarrow r=\dfrac{44}{2\pi}=\dfrac{44\times7}{2\times22}=7$ cm

$\therefore$ Area of circle = $\pi r^2$

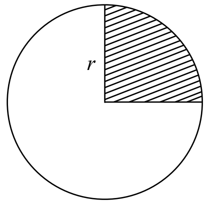
$=\dfrac{22}{7}\times7\times7=154 \text{ cm}^2$

**97.** **(b)**

$\therefore$ Area of sector $=\dfrac{1}{4}\times154 \text{ cm}^2$

$\therefore$ Angle created by sector

$=\dfrac{\text{Area of segment}}{\text{Area of circle}}\times360^\circ=\dfrac{1}{4}\times360^\circ=90^\circ$




$\Rightarrow$ Again area of circle = 154 cm$^2$

$\Rightarrow$ Radius of circle $=\sqrt{\dfrac{154}{\pi}}=\sqrt{7^2}=7$ cm.

$\therefore$ Perimeter of the sector $=\dfrac{90^\circ}{360^\circ}\times2\pi r+2r$

$$=\frac{1}{4}\times 2\pi r+2r=\frac{1}{4}\times 2\times\frac{22}{7}\times 7+2\times 7$$

= (11 + 14) cm = 25 cm

**98.** **(a)** Required sum $=20^2+\cdots+29^2$

$=(1^2+\cdots+29^2)-(1^2+\cdots+19^2)$

$$=\frac{29(29+1)(2\times 29+1)}{6}-\frac{19(19+1)(2\times 19+1)}{6}$$

$$=\frac{29\times 30\times 59}{6}-\frac{19\times 20\times 39}{6}$$

$=8555-2470=6085$ cm$^2$

**99.** (a) In $\Delta BDE$

$DC$ = 28 cm (because diameter of each circle is 14 cm)

Now, $DE=DC+CE=28+28=56$ cm

And $BC$ = 28 cm

Again, area of $\Delta BDE$

$$=\frac{1}{2}\times DE\times BC=\frac{1}{2}\times 56\times 28=784\text{ m}^2$$

**100.** **(b)** Area of the square = 28 × 28 = 784 cm$^2$

Area of the four circles = $4pr^2$

$$=4\times\frac{22}{7}\times 7\times 7=28\times 22=616\text{ m}^2$$

∴ Area of the shaded parts = 784 − 616 = 168 cm$^2$

**101.** **(d)** Area of the square = 1444

Let, the side of the square be $a$.

So, $a^2$ = 1444

$\therefore\ a=\sqrt{1444}=38$ m

Breadth of rectangle $=\frac{1}{4}\times 38=9.5$ m

Length = 3 × 9.5 = 28.5 m

Area of rectangle = 28.5 × 9.5 = 270.75 m$^2$

∴ Difference = 1444 – 270.75 = 1173.25 m$^2$

**102.** **(e)** Let the length and breadth of the original rectangle be $L$ m and $B$ m, respectively.

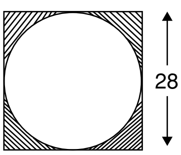
After increasing the length by 20% and decreasing the breadth by 20%, area is 192.

$(1.2L)\times(0.8B)=192$

or, $0.96\ LB=192$

or $LB=200$

**103.** **(d)**




We have to calculate the area of the shaded region which is equal to

Area of square – Area of the circle.

Required answer $=(28)2-\frac{22}{7}\times 14\times 14$

$$=784-616=168\text{ m}^2$$

**104.** **(c)** Using statements I and II we can find the area of the rectangle and using statement III we can find the cost.

**105.** (c) Let, the side of the square be $a$.

∴ Length of the rectangle $=\frac{3a}{5}$

Radius of the circle = $a$

Circumference of the circle = $2\pi a$ = 132

$\Rightarrow\ a=\frac{132}{2\pi}=21$

Now, area of the rectangle = length × breadth

$=\frac{3}{5}\times 21\times 8=100.8\text{ cm}^2$

**106.** **(c)** Side of the square $=\frac{56}{4}=14$ cm

∴ smallest side of the triangle = 14 – 8 = 6 cm

Length of the rectangle $=\frac{96}{8}=12$ cm

Second largest side of the triangle = 112 – 4 = 8 cm

∴ Largest side of the triangle $=\sqrt{6^2+8^2}$

$=\sqrt{36+64}=\sqrt{100}=10$ cm

**107.** **(c)** Circumference of the circle = $p\times$diameter

$=\frac{22}{7}\times 56=176$ cm

∴ Perimeter of the square = 272 − 176 = 96 cm

∴ Side of the square $=\left(\frac{96}{4}\right)=24$ cm

∴ Area of the square = 24 × 24 = 576 cm$^2$

∴ Area of the circle $=\pi r^2=\frac{22}{7}\times 28\times 28=2464$ cm$^2$

∴ Required sum = 576 + 264 = 3040 cm$^2$

**108.** **(c)** The smallest angle of the triangle is half of the largest angle.

∴ Ratio of the three angle = 4:3:2

∴ $4x+3x+2x=180$

∴ $9x=180$

∴ $x=20$

∴ Required difference = $4x-2x=2x=2\times 20=40°$

**109.** (d) Let, the three angles of the quadrilateral be $13x°$, $19x°$ and $5x°$, respectively.

Now, according to the question,

$13x + 9x + 5x = 360 - 36 = 324$

$\Rightarrow \quad 27x = 324$

$\therefore \quad x = \frac{324}{27} = 12$

$\therefore$ Required difference = $13x - 5x = 8x = 8 \times 12 = 96°$

**110. (e)** $2\pi r = 88$ (smaller circle)

$\therefore \quad r = 14$ m

$2\pi R = 220$ m (larger circle)

$\therefore \quad R = 35$ m

Difference between their areas

$= \pi(R^2 - r^2) = \frac{22}{7}(35^2 - 14^2)$

$= \frac{22}{7} \times 49 \times 21 = 22 \times 7 \times 21 = 3234 \text{ m}^2.$

**111. (b)** $(2x + 4x + 7x + 5x) = 18x = 360°$

$\Rightarrow \quad x = 20°$

$\therefore$ Smallest angle of the quadrilateral = $2x = 2 \times 20 = 40°$

So the smallest angle of the triangle = 40°

Remaining two angles of the triangle are

40 × 2 = 80° and 180 – (80 + 40)

= 180 – 120 = 60°

**112. (e)** Side of the square

$= \sqrt{1,024} \text{ cm}^2 = 32$ cm

Length of the rectangle = 32 × 2 cm

Breadth of the rectangle = 32 – 12 = 20 cm

Required ratio = 64:20 = 16:5

**113. (a)** Perimeter of the rectangle = 2(8 + 7) = 30 cm

Perimeter of the square = 2 × 30 = 60 cm

$\therefore$ Side of the square $= \frac{1}{4} \times 60 = 15$ cm

Circumference of the required semi-circle

$= \pi r + 2r = \frac{22}{7} \times \frac{15}{2} + 2 \times \frac{15}{2} = 38.57$ cm.

**114. (c)** $r_1 = \frac{132 \times 7}{2 \times 22} = 21$ m

$r_2 = \frac{176 \times 7}{2 \times 22} = 28$ m

Required difference $= \pi\{(28)^2 - (21)^2\}$

$= \frac{22}{7} \times 49 \times 7 = 1078 \text{ m}^2$

**115. (c)** Radius of the circle = $r$

$r = \frac{\sqrt{39424 \times 7}}{22} = \sqrt{12544} = 112$ cm

Also, 4 × side = 112 implies that

side = 28 cm

Area of the square = $(\text{side})^2 = (28)^2 = 784 \text{ cm}^2$

**116. (b)** Required cost

$= 4 \times \sqrt{361} \times 62 = 4 \times 19 \times 62 = ₹4712$

**117. (a)** Let the breadth be $x$.

Then, length = $2x$.

$\therefore \quad 2x^2 = \frac{256}{2} \Rightarrow x^2 = 64;$

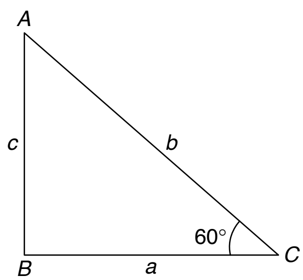
**118. (d)**

**From I.** $AC$ = 5cm

**From II.** Perimeter = 4 × base

**From III.** One of the angles of the triangle, say $\angle C$, be 60°.

**FromI and III.** $\cos 60° = \frac{BC}{AC}$




or, $BC = AC \times \cos 60° = \frac{5}{2}$

$a = \frac{5}{2}, b = 5 (\because AC = b)$

Now, area of the triangle $ABC = \frac{1}{2} ab \sin\theta$

$= \frac{1}{2} \times \frac{5}{2} \times 5 \times \sin 60°$

$= \frac{5}{4} \times \frac{\sqrt{3}}{2} = \frac{25}{8}\sqrt{3} \text{ cm}^2$

Hence, statement I and III are sufficient to answer the question.

# Mensuration II: Volume and Surface Area

# 34

## INTRODUCTION

### Solids

A *solid* is a figure bounded by one or more surfaces. It has three dimensions, namely, length, breath or width, and thickness or height. The plane surfaces that bind it are called its *faces*.

The *volume* of any solid figure is the amount of space enclosed within its bounding faces. It is measured in cubic units, e.g., $m^3$, $cm^3$, etc.

The area of the plane surfaces that bind the solid is called its *surface area*.

For any regular solid,

Number of faces + Number of vertices

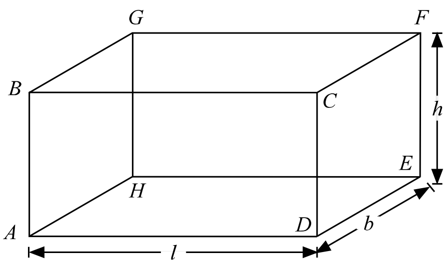
= Number of edges + 2.

We discuss here some important three-dimensional figures and the formulae associated with them.

### Cubic

It is ta solid figure which has six rectangular faces. It is also called *rectangular parallelopiped.*

## SOME BASIC FORMULAE




If $l$, $b$ and $h$ denote the length, breadth and height of the cuboid, and $d$ denotes the body diagonal ($AF$ or $BE$ or $DG$ or $CH$), then

(i) Volume $= l \times b \times h = \sqrt{A_1 \times A_2 \times A_3}$,

where, $A_1$ = area of base or top,
$A_2$ = area of one side face, and
$A_3$ = area of other side face.

(ii) Total surface area $= 2(lb + bh + lh)$
$= (l + b + h)^2 - d^2$

(iii) Diagonal of cuboid $= \sqrt{l^2 + b^2 + h^2}$

***Notes***:

1. For painting the surface area of a box or to know how much tin sheet is required for making a box, we use formula (ii).
2. To find how much a box contains or how much space a box shall occupy, we use formula (i). To find the length of the longest pole to be placed in a room, we use formula (iii).
3. The rise or fall of liquid level in a container

$$= \frac{\text{Total volume of objects submerged or taken out}}{\text{Cross-sectional area of container}}.$$

**Illustration 1:** Find the volume and the total surface area of a cuboid whose dimensions are 25 m, 10 m and 2 m.

**Solution:** Here, $l = 25$ m, $b = 10$ m and $h = 2$ m.

Volume of the cuboid $= l \times b \times h$
$= 25 \times 10 \times 2$
$= 500 \text{ m}^3$

Total surface area of the cuboid

$= 2\ (lb + bh + lh)$
$= 2\ (25 \times 10 + 10 \times 2 + 25 \times 2)$
$= 2\ (250 + 20 + 50)$
$= 640\ \text{m}^2$.

**Illustration 2:** Find out the length of the longest bamboo that can be placed in a room which is 12 m long, 9 m broad and 8 m high.

**Solution:** Length of the bamboo

= length of the diagonal of the room

$= \sqrt{12^2 + 9^2 + 8^2}$

$= \sqrt{289} = 17$ m.

**Illustration 3:** The area of a side of a box is 120 cm$^2$. The area of the other side of the box is 27 cm$^2$. If the area of the upper surface of the box is 60 cm$^2$, then find out the volume of the box.

**Solution:** Volume to the box

$$= \sqrt{\text{area of base} \times \text{area of one face} \times \text{area of the other face}}$$

$$= \sqrt{60 \times 120 \times 72}$$

$$= \sqrt{518400} = 720\ \text{cm}^3.$$

**Illustration 4:** The sum of length, breadth and height of a cuboid is 12 cm. Find out the total surface area of the cuboid.

**Solution:** Total surface area

$= (\text{Sum of all three sides})^2 - (\text{Diagonal})^2$
$= 12^2 - 8^2 = 144 - 64 = 80\ \text{cm}^2$.

## Cube

It is a special type of cuboid in which each face is a square.

For a cube, length, breadth and height are equal and is called, the edge of the cube,

If $a$ be the edge of a cube, then

(i) Volume of the cube = $(\text{edge})^3 = a^3$

(ii) Total surface area of the cube = $6\ (\text{edge})^2 = 6a^2$

(iii) Diagonal of the cube = $\sqrt{3}a$ (edge) = $\sqrt{3}a$

(iv) Volume of the cube $= \left(\dfrac{\text{diagonal}}{\sqrt{3}}\right)^3 = \left(\dfrac{d}{\sqrt{3}}\right)^2$

$$= \left(\sqrt{\frac{\text{Surface area}}{6}}\right)^3$$

(v) Total surface area of the cube

$= 2\ (\text{diagonal})^2 = 2d^2$

(vi) For two cubes

(a) Ratio of volumes = $(\text{ratio of sides})^3$
(b) Ratio of surface areas = $(\text{Ratio of sides})^2$
(c) $(\text{Ratio of surface areas})^3 = (\text{Ratio of volumes})^2$.

**Illustration 5:** Find out the volume, surface area and the diagonal of a cube, each of whose sides measures 4 cm.

**Solution:** Volume of the cube $= a^3 = (4)^3 = 64\ \text{cm}^3$.

Surface area of the cube $= 6a^2 = 6\ (4)^2 = 96\ \text{cm}^2$.

Diagonal of the cube $= \sqrt{3}a = 4\sqrt{3}$ cm.

**Illustration 6:** The surface area of a cube is 216 cm$^2$. Find out its volume.

**Solution:** Volume of the cube

$$= \left(\sqrt{\frac{\text{Surface area}}{6}}\right)^3$$

$$= \left(\sqrt{\frac{216}{6}}\right)^3 = (6)^3 = 216\ \text{cm}^3.$$

**Illustration 7:** The diagonal of a cube is $8\sqrt{3}$ cm. Find out its total surface area and volume.

**Solution:** We have,

Diagonal of cube $= \sqrt{3}$ (edge)

$\therefore$ Edge of cube $= \dfrac{\text{Diagonal of cube}}{\sqrt{3}}$

$$= \frac{8\sqrt{3}}{\sqrt{3}} = 8\ \text{cm}.$$

Total surface area $= 6\ (\text{edge})^2 = 6(8)^2$
$= 384\ \text{cm}^2$.

Volume of cube $= (\text{edge})^3 = (8)^3 = 512\ \text{cm}^3$.

**Illustration 8:** If the volumes of two cubical blocks are in the ratio of 8:1, then what will be the ratio of their edges?

**Solution:** We have,

Ratio of volumes = $(\text{Ratio of sides})^3$

Since, ratio of volumes = 8:1, i.e., $2^3:1^3$

$\therefore$ ratio of sides = 2:1.

**Illustration 9:** Volumes of the two cubes are in the ratio of 1:9. Find the ratio of their surface areas.

**Solution:** $(\text{Ratio of the surface areas})^3$

$= (\text{Ratio of volumes})^2$

$\therefore$ Ratio of surface areas $= \sqrt[3]{1:81} = 1:3\ (3)^{1/3}$.

**Illustration 10:** Sides of two cubes are in the ratio of 2:3. Find out the ratio of their surface areas.

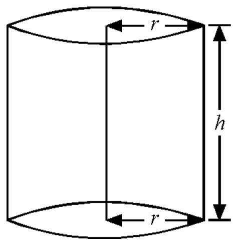
**Solution:** Ratio of surface areas

= (Ratio of sides)$^2$

= $(2:3)^2$ = 4:9.

## Right Circular Cylinder

A *right circular cylinder* is a solid with circular ends of equal radius and the line joining their centres perpendicular to them. This is called, axis of the cylinder. The length of the axis is called, the height of the cylinder.




***Note*:**

Take a rectangular sheet of paper and role it lengthwise or breadthwise in a round way, you will get a cylinder, i.e., a cylinder is generated by rotating a rectangle by fixing one of its sides.

If $r$ is the radius of base and $h$ is the height of the cylinder, then

(i) Volume of cylinder

= Area of the base × height

= $\pi r^2 \times h = \pi r^2 h$ cubic units

(ii) Area of the curved surface

= Circumference of the base × height

= $2\pi r \times h = 2\pi rh$ sq units

(iii) Area of the total surface

= Area of the curved surface + Area of the two circular ends

= $2\pi rh + 2\pi r^2$

= $2\pi r(h + r)$ sq units.

(iv) For two cylinders,

When radii are equal

(a) Ratio of volumes = Ratio of heights

(b) Ratio of volumes = Ratio of curved surface areas

(c) Ratio of curved surface areas = Ratio of heights

When heights are equal

(a) Ratio of volumes = (Ratio of radii)$^2$

(b) Ratio of volumes = (Ratio of curved surface areas)$^2$

(c) Radii of curved surface areas = Ratio of radii

When volumes are equal

(a) Ratio of radii = $\sqrt{\text{Inverse ratio of heights}}$

(b) Ratio of curved surface areas = Inverse ratio of radii

(c) Ratio of curved surface areas = $\sqrt{\text{Ratio of heights}}$

When curved surface areas are equal

(a) Ratio of radii = Inverse ratio of heights

(b) Ratio of volumes = Inverse ratio of heights

(c) Ratio of volumes = Ratio of radii

(v) For a cylinder

(a) Ratio of radii = (Ratio of curved surfaces) × (Inverse ratio of heights)

(b) Ratio of heights = (Ratio of curved surfaces) × (Inverse ratio of radii)

(c) Ratio of curved surfaces = (Ratio of radii) × (Ratio of heights).

**Illustration 11:** The diameter of the base of a right circular cylinder is 28 cm and its height is 10 cm. Find out the volume and area of the curved surface of the cylinder.

**Solution:** Radius of the base = $\frac{28}{2}$ = 14 cm.

Volume of the cylinder = $\pi r^2 h$

$= \frac{22}{7} \times 14 \times 14 \times 10$

= 6160 cm$^3$.

Area of the curved surface = $2\pi rh$

$= 2 \times \frac{22}{7} \times 14 \times 10$

= 880 cm$^2$.

**Illustration 12:** A cylinder of height 21 cm has base of radius 4 cm. Find out the total surface area of the cylinder.

**Solution:** Total surface area = $2\pi r(h + r)$

$= 2 \times \frac{22}{7} \times 4 \times (21 + 4)$

$= \frac{4400}{7} = 628\frac{4}{7}$ cm$^2$.

**Illustration 13:** A rectangular piece of paper is 71 cm long and 10 cm wide. A cylinder is formed by rolling the paper along its breadth. Find out the volume of the cylinder. $\left[\text{Take } \pi = \frac{355}{113}\right]$

**Solution:** Circumference of the paper = Breadth of the paper

$\Rightarrow \quad 2\pi r = 10$

$\Rightarrow \quad r = \frac{10}{2\pi} = \frac{10 \times 113}{2 \times 355} = \frac{113}{71}$ cm.

As the length of the paper becomes the height of the cylinder,

$\therefore$ Volume of the cylinder

$= \pi r^2 l$

$= \frac{355}{113} \times \frac{113}{71} \times \frac{113}{71} \times 71 = 565 \text{ cm}^3.$

**Illustration 14:** Two circular cylinders of equal volume have their heights in the ratio of 9:16. Find out the ratio of their radii.

**Solution:** Ratio of radii = $\sqrt{\text{inverse ratio of heights}}$

$= \sqrt{16:9} = 4:3.$

**Illustration 15:** Two circular cylinders of equal volume have their heights in the ratio of 16:25. Find out the ratio of their curved surface areas.

**Solution:** Ratio of curved surface areas

$= \sqrt{\text{Ratio of heights}} = \sqrt{16:25} = 4:5.$

**Illustration 16:** Two circular cylinders of equal volume have their radii in the ratio of 4:9. Find out the ratio of their curved surface areas.

**Solution:** Ratio of curved surface areas

= inverse ratio of radii = 9:4.

**Illustration 17:** Two circular cylinders of equal heights have their radii in the ratio of 2:5. Find out the ratio of their volumes.

**Solution:** Ratio of volumes = (Ratio of radii)$^2$ = 4:25.

**Illustration 18:** Two circular cylinders of equal heights have their curved surface areas in the ratio of 3:5. Find out the ratio of their volumes.

**Solution:** Ratio of volumes

= (Ratio of curved surface areas)$^2$

= 9:25.

**Illustration 19:** Two circular cylinders of equal curved surface areas have their heights in the ratio of 4:7. Find out the ratio of their volumes.

**Solution:** Ratio of volumes = Inverse ratio of heights

$= \frac{1}{4} : \frac{1}{7} = 7:4.$

**Illustration 20:** Two circular cylinders of equal curved surface areas have their heights in the ratio of 4:5. Find out the ratio of their volumes.

**Solution:** Ratio of volumes = Inverse ratio of heights

$= \frac{1}{4} : \frac{1}{5} = 5:4.$

> (vi) If the ratio of heights and the ratio of radii of two right circular cylinders are given, then
>
> Ratio of curved surface areas = (ratio of radii) (ratio of heights).

**Illustration 21:** If the heights and the radii of two right circular cylinders are in the ratio 2:3 and 4:5, respectively. Find out the ratio of their curved surface areas.

**Solution:** Ratio of curved surface areas = (ratio of radii) (ratio of heights)

= (4:5) (2:3) = 8:15.

> (vii) If the ratio of heights and the ratio of curved surface areas of two right circular cylinders are given, then
>
> Ratio of radii = (ratio of curves surface areas) (inverse ratio of heights).

**Illustration 22:** The heights and curved surface areas of two right circular cylinders are in the ratio 3:4 and 5:8, respectively. Find out the ratio of their radii.

**Solution:** Ratio of radii = (ratio of curved surface areas) (inverse ratio of heights)

$= (5:8) \left(\frac{1}{3} : \frac{1}{4}\right) = (5:8)\ (4:3) = 5:6.$

> (viii) If the ratio of radii and the ratio of curved surface areas of two right circular cylinders are given, then
>
> Ratio of heights = (ratio of curved surface areas) (inverse ratio of radii)

**Illustration 23:** The radii of two right circular cylinders are in the ratio of 3:4 and their curved surface areas are in the ratio of 5:6. Find out the ratio of their heights.

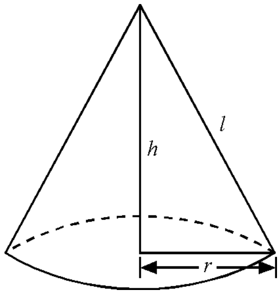
**Solution:** Ratio of heights = (ratio of curved surface areas) (inverse ratio of radii)

$= (5:6) \left(\frac{1}{3} : \frac{1}{4}\right)$

$= (5:6)\ (4:3) = 10:9.$

### Right Circular Cone

A *right circular cone* is a solid obtained by rotating a right-angled triangle around its height.




If $r$ = radius of base; $h$ = height,

$l$ = slant height = $\sqrt{h^2 + r^2}$ , then

(i) Volume of cone

$$= \frac{1}{3} \times \text{area of the base} \times \text{height}$$

$$= \frac{1}{3} \times \pi r^2 h \text{ cubic units}$$

(ii) Area of curved surface = $\pi rl$

$$= \pi r\sqrt{h^2 + r^2} \text{ sq. units}$$

(iii) Total surface area of cone

= Area of the base + area of the curved surface

$= \pi r^2 + \pi rl = \pi r (r + l)$ sq units.

(iv) For two cones

(a) When volumes are equal
Ratio of radii = $\sqrt{\text{inverse ratio of heights}}$

(b) When radii are equal
Ratio of volumes = Ratio of heights

(c) When heights are equal
Ratio of volumes = (ratio of radii)$^2$

(d) When curved surface areas are equal
Ratio of radii = inverse ratio of slant heights.

**Illustration 24:** Find out the slant heights of a cone whose volume is 1232 cm$^3$ and radius of the base is 7 cm.

**Solution:** Volume of the cone = $\frac{1}{3}\pi r^2 h$ = 1232

$$\Rightarrow \quad h = \frac{1232 \times 3}{\pi r^2} = \frac{1232 \times 3 \times 7}{22 \times 7 \times 7} = 24 \text{ cm.}$$

Slant height $l$ is given by the relation

$$l = \sqrt{h^2 + r^2}$$

$$= \sqrt{(24)^2 + (7)^2} = \sqrt{576 + 49}$$

$$= \sqrt{625} = 25 \text{ cm.}$$

$\therefore$ Slant height of the cone is 25 cm.

**Illustration 25:** A tent is of diameter 12 m at the base and its height is 8 m.

(i) Find the slant height; and

(ii) The canvas required in m$^2$.

How many persons can the tent accommodate, at the most, if each person requires 18 m$^3$ of air?

**Solution:** Diameter of the base of a conical tent = 12 m.

$\therefore$ Radius ($r$) = $\frac{12}{2}$ = 6 m and its height ($h$) = 8 m.

(i) Slant height ($l$) = $\sqrt{r^2 + h^2} = \sqrt{6^2 + 8^2}$

$$= \sqrt{64 + 36} = \sqrt{100} = 10 \text{ m.}$$

(ii) Area of canvas required

$$= \pi \times r \times l$$

$$= \frac{22}{7} \times 6 \times 10 = 188.57 \text{ m}$$

(iii) Volume of conical portion

$$= \frac{1}{3}\pi r^2 h$$

$$= \frac{1}{3} \times \frac{22}{7} \times 6 \times 6 \times 8 = 301.71 \text{ m}^3.$$

Space required for each person = 18 m$^3$.

$\therefore$ Number of persons that can be accommodated

$$= \frac{301.71}{18} = 16.$$

**Illustration 26:** The height of a cone is 21 cm and radius of its base is 28 cm. Find out its total surface area.

**Solution:** We have, $r$ = 28 cm and $h$ = 21 cm.

Slant height ($l$) = $\sqrt{r^2 + h^2} = \sqrt{(28)^2 + (21)^2}$

$$= \sqrt{1225} = 35 \text{ cm.}$$

Total surface area = $\pi r (l + r)$

$$= \frac{22}{7} x \ 28 \times (35 + 28)$$

$$= \frac{22}{7} \times 28 \times 63$$

$$= 5544 \text{ cm}^2.$$

**Illustration 27:** Two right circular cones of equal curved surface areas have their slant heights in the ratio of 3:5. Find out the ratio of their radii.

**Solution:** Ratio of radii = inverse ratio of slant heights

$$= \frac{1}{3} : \frac{1}{5} = 5:3.$$

**Illustration 28:** Two right circular cones of equal volumes have their heights in the ratio of 4:9. Find out the ratio of their radii.

**Solution:** Ratio of radii $= \sqrt{\text{inverse ratio of heights}}$

$$= \sqrt{\frac{1}{4} : \frac{1}{9}} = \sqrt{9:4} = 3:2.$$

**Illustration 29:** Two right circular cones of equal heights have their radii in the ratio of 1:3. Find out the ratio of their volumes.

**Solution:** Ratio of volumes = (Ratio of radii)$^2$

$$= (1:3)^2 = 1:9.$$

(v) If the ratio of volumes and the ratio of heights of two right circular cones (or cylinders) are given, then

Ratio of radii

$$= \sqrt{(\text{ratio of volumes})(\text{inverse ratio of heights})}$$

$$= \sqrt{(3:2)(8:3)} : \sqrt{4:1} = 2:1.$$

**Illustration 30:** The volumes of two cones are in the ratio 3:2 and their heights in the ratio 3:8. Find out the ratio of their radii.

**Solution:** Ratio of radii

$$= \sqrt{(\text{ratio of volumes})(\text{inverse ratio of heights})}$$

$$= \sqrt{(3:2)(8:3)} = \sqrt{4:1} = 2:1.$$

(vi) If the ratio of heights and the ratio of diameters (or radii) of two right circular cones (or cylinders) are given, then

Ratio of volumes = (ratio of radii)$^2$ × (ratio of heights).

**Illustration 31:** The heights of two cones are in the ratio of 5:3 and their radii is in the ratio 2:3. Find out the ratio of their volumes.

**Solution:** Ratio of volumes

$$= (\text{ratio of radii})^2 \times (\text{ratio of heights})$$

$$= (2:3)^2 \times (5:3)$$

$$= \frac{4}{9} \times \frac{5}{3} = 20:27.$$

(vii) If the ratio of radii (or diameter) and the ratio of volumes of two right circular cones are given, then

ratio of heights

= (inverse ratio of radii)$^2$ (ratio of volumes).

**Illustration 32:** The volumes of two cones are in the ratio of 1:4 and their diameters are in the ratio of 4:5. Find out the ratio of their heights.

**Solution:** Ratio of heights

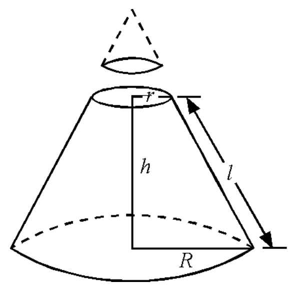
$$= (\text{inverse ratio of diameters})^2 \times (\text{ratio of volumes})$$

$$= \left(\frac{1}{4} : \frac{1}{5}\right)^2 (1:4) = (5:4)^2 (1:4)$$

$$= \frac{25}{16} \times \frac{1}{4} = 25:64.$$

## Frustum of a Right Circular Cone

A cone with some of its top portion cut off is called, the *frustum* of the original cone.




If $R$ = Radius of the base of frustum
$r$ = Radius of the top of the frustum
$h$ = Height of the frustum
$l$ = Slant height of the frustum, then

(a) Slant height $= \sqrt{h^2 + (R - r)^2}$ units

(b) Area of the curved surface $= \pi (R + r) l$ sq. units

(c) Total surface area of the frustum $= \pi [(R^2 + r^2) + l (R + r)]$ sq. units

(d) Volume of the frustum $= \frac{\pi h}{3} (R^2 + r^2 + Rr)$ cu units.

**Illustration 33:** A reservoir is in the shape of a frustum of a right circular cone. It is 8 m across at the top and 4 m across the bottom. It is 6 m deep. Find out the area of its curved surface, total surface area and also its volume.

**Solution:** Here, $R = 4$, $r = 2$ and $h = 6$.

$\therefore$ Slant height $(l) = \sqrt{h^2 + (R - r)^2}$

$$= \sqrt{(6)^2 + (4-2)^2} = \sqrt{40}.$$

$\therefore$ Area of the curved surface

$$= \pi (R + r)\, l$$

$$= \frac{22}{7}(4+2)\sqrt{40}$$

$$= 18.8 \times 6.3 = 118.4 \text{ m}$$

Total surface area $= \pi\, [(R^2 + r^2) + l\,(R + r)]$

$$= \frac{22}{7}[(4^2+2^2)+\sqrt{40}\,(4+2)]$$

$$= \frac{22}{7}(20+6\sqrt{40}) = 181.6 \text{ m}^2$$

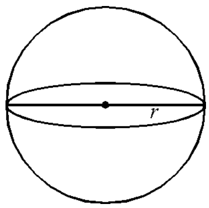
Volume of the frustum $= \dfrac{\pi h}{3}(R^2+r^2+Rr)$

$$= \frac{22}{7}\times\frac{6}{3}(4^2+2^2+4\times 2)$$

$$= \frac{44}{7}(20+4+8) = 176 \text{ m}^3.$$

### Sphere

A *sphere* is the solid figure formed by revolving a semi-circle on its diameter.

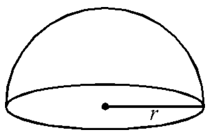



The mid-point of the diameter is called, centre of the sphere, and the radius of the semi-circle is called, the radius of the sphere.

If $r$ = radius of the spheres, then

(i) Volume of sphere $= \dfrac{4}{3}\pi r^3$ cubic units

(ii) Surface area $= 4\pi r^2$ sq units.




(iii) Volume of hemisphere $= \dfrac{2}{3}\pi r^2$ cubic units

(iv) Area of curved surface $= 2\pi r^2$ sq units of hemisphere

(v) Total surface area of hemisphere $= 3\pi r^2$ sq units.

**Illustration 34:** Diameter of a sphere is 28 cm. Find out its surface area and volume.

**Solution:** Radius of the sphere $(r) = \dfrac{28}{2} = 14$ cm.

Surface area $= 4\pi r^2 = 4 \times \dfrac{22}{7}\times 14\times 14$

$= 2464 \text{ cm}^2$.

Volume of sphere $= \dfrac{4}{3}\pi r^3$

$$= \frac{4}{3}\times\frac{22}{7}\times 14\times 14\times 14$$

$= 11498.6 \text{ cm}^3$.

**Illustration 35:** Find out the volume, curved surface area and total surface area of a hemisphere of radius 21 cm.

**Solution:** Volume of the hemisphere

$$= \frac{2}{3}\pi r^3 = \frac{2}{3}\times\frac{22}{7}\times 21\times 21\times 21 = 19494 \text{ cm}^3.$$

Curved surface area $= 2\pi r^2$

$$= 2 \times \frac{22}{7}\times 21\times 21$$

$= 2772 \text{ cm}^2$.

Total surface area $= 3\pi r^2$

$$= 3 \times \frac{22}{7}\times 21\times 21$$

$= 4158 \text{ cm}^2$.

(vi) For two spheres

(a) $(\text{Ratio of radii})^2$ = Ratio of surface areas
(b) $(\text{Ratio of radii})^3$ = Ratio of volumes
(c) $(\text{Ratio of surface areas})^3$ $= (\text{Ratio of volumes})^2$.

**Illustration 36:** The radii of two spheres are in the ratio of 2:3. What is the ratio of their surface areas?

**Solution:** Ratio of surface areas $= (\text{ratio of radii})^2$

$= (2:3)^2 = 4:9$.

**Illustration 37:** The surface areas of two spheres are in the ratio 1:2. Find out the ratio of their volumes.

**Solution:** We have,

$(\text{Ratio of surface areas})^3 = (\text{Ratio of volumes})^2$

$\Rightarrow\ (1:2)^3 = (\text{Ratio of volumes})^2$

$\therefore$ Ratio of volumes $= \sqrt{1:8} = 1:2\sqrt{2}$.

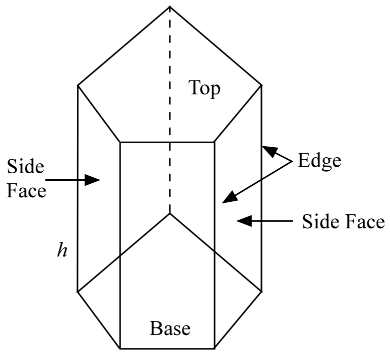
**Illustration 38:** The radii of two spheres are in the ratio of 2:45. Find out the ratio of their volumes.

**Solution:** Ratio of volumes $= (\text{Ratio of radii})^3$

$= (2:5)^3 = 8:125$.

### Prism

A solid having top and bottom faces identical and side faces rectangular is a prism.




In a prism with a base of $n$ sides;
Number of vertices = $2n$
and Number of faces = $n + 2$.
Volume of the prism = area of base × height
Lateral surface area = perimeter of base × height

Total surface area = 2 × Base area + Lateral Surface area.

**Illustration 39:** Find out the volume and the total surface area of a triangular prism whose height is 30 m and the sides of whose base are 21 m, 20 m and 13 m, respectively.

**Solution:** Perimeter of base = 21 + 20 + 13 = 54 m.
height = 30 m.

$$\text{Area of base} = \sqrt{s(s-a)(s-b)(s-c)}$$
$$= \sqrt{27(27-21)(27-20)(27-13)}$$
$$= \sqrt{27\times6\times7\times14} = 126 \text{ m}^2.$$

∴ Volume of the prism = area of base × height $= 126 \times 54 = 6804 \text{ m}^3$.

Also, surface area of the prism
= 2 × Base area + lateral surface area
= 2 Base area + perimeter of base × height
$= 2 \times 126 + 54 \times 30 = 1872 \text{ m}^2$.

## SOLIDS INSCRIBED/CIRCUMSCRIBING OTHER SOLIDS

**1.** If a largest possible sphere is circumscribed by a cube of edge '$a$' cm, then the radius of the sphere $= \dfrac{a}{2}$.

**Illustration 40:** Find out the volume of largest possible sphere circumscribed by a cube of edge 8 cm.

**Solution:** Radius of the sphere $= \dfrac{a}{2} = \dfrac{8}{2} = 4$ cm.

$$\therefore \text{ Volume of the sphere} = \frac{4}{3}\pi r^3$$
$$= \frac{4}{3}\times\frac{22}{7}\times4\times4\times4$$
$$= 26.81 \text{ cm}^3.$$

**2.** If a largest possible cube is inscribed in a sphere of radius '$a$' cm, then the edge of the cube $= \dfrac{2a}{\sqrt{3}}$.

**Illustration 41:** Find out the surface area of largest possible cube inscribed in a sphere of radius 4 cm.

**Solution:** Edge of the cube $\dfrac{2a}{\sqrt{3}} = \dfrac{2\times4}{\sqrt{3}} = \dfrac{8}{\sqrt{3}}$.

$$\therefore \text{ Surface area of the cube} = 6\,(\text{edge})^2$$
$$= 6 \times \frac{64}{3}$$
$$= 128 \text{ cm}^2.$$

**3.** If a largest possible sphere is inscribed in a cylinder of radius '$a$' cm and height '$h$' cm, then

$$\text{radius of the sphere} = \begin{cases} a \text{ for } h > a \\ \dfrac{h}{2} \text{ for } a > h \end{cases}$$

**Illustration 42:** Find out the surface area of largest possible sphere inscribed in a cylinder of radius 14 cm and height 17 cm.

**Solution:** Radius of the sphere = 14 cm ($\because h > a$)

$$\therefore \text{ Surface area of sphere} = 4\pi r^2$$
$$= 4 \times \frac{22}{7}\times14\times14$$
$$= 2464 \text{ cm}^2.$$

**4.** If a largest possible sphere is inscribed in a cone of radius '$a$' cm and slant height equal to the diameter of the base, then radius of the sphere $= \dfrac{a}{\sqrt{3}}$.

**Illustration 43:** Find out the surface area of largest possible sphere inscribed in a cone of radius 21 cm and slant height equal to the diameter of the base.

**Solution:** Radius of the sphere $= \dfrac{a}{\sqrt{3}} = \dfrac{21}{\sqrt{3}}$ cm.

$\therefore$ Surface area of the sphere $= 4\pi r^2$

$$= 4 \times \frac{22}{7} \times \frac{21}{\sqrt{3}} \times \frac{21}{\sqrt{3}}$$

$$= 1848 \text{ cm}^2.$$

**5.** If a largest possible cone is inscribed in a cylinder of radius '$a$' cm and height '$h$' cm, then radius of the cone $= a$ and height $= h$.

**Illustration 44:** Find out the volume of largest possible cone inscribed in a cylinder of radius 6 cm and height 14 cm.

**Solution:** Radius of the cone $(r) = 6$ cm.

and height of the cone $(h) = 14$ cm.

$\therefore$ Volume of the cone $= \dfrac{1}{3}\pi r^2 h$

$$= \frac{1}{3} \times \frac{22}{7} \times 6 \times 6 \times 14$$

$$= 528 \text{ cm}^2.$$

**6.** If a largest possible cube is inscribed in a hemisphere of radius '$a$' cm, then the edge of the cube $= a\sqrt{\dfrac{2}{3}}$.

**Illustration 45:** Find out the length of the diagonal of largest possible cube inscribed in a hemisphere of radius $4\sqrt{2}$ cm.

**Solution:** Edge of the cube $= a\sqrt{\dfrac{2}{3}} = 4\sqrt{2} \times \sqrt{\dfrac{2}{3}} = \dfrac{8}{\sqrt{3}}$ cm.

$\therefore$ Diagonal of the cube $= \sqrt{3}$ (edge)

$$= \sqrt{3} \times \frac{8}{\sqrt{3}} = 8 \text{ cm}.$$

## SOME USEFUL SHORT-CUT METHODS

**1.** If all three measuring dimensions of a sphere, cuboid, cube, cylinder or cone are increased or decreased by $x\%$, $y\%$ and $z\%$ respectively, then the volume of the figure will increase or decrease by

$$\left(x + y + z + \frac{xy + yz + zx}{100} + \frac{xyz}{100^2}\right)\%$$

For cuboid, the three measuring dimensions are length, breadth and height.

For cube, all three measuring dimensions are equal, i.e., $x = y = z$.

For sphere also, (or diameter) all three measuring dimensions are equal and is given by radius, i.e., $x = y = z = r$.

For cylinder or a cone two measuring dimensions are equal to radius and third measuring dimension is height

i.e., $x = y = r$ and $z = h$.

**Illustration 46:** The length, breadth and height of a cuboid are increased by 5%, 10% and 20%, respectively. Find out the percentage increase in its volume.

**Solution:** Here, $x = 5$, $y = 10$ and $z = 20$.

$\therefore$ Percentage increase in volume

$$= \left[x + y + z + \frac{xy + xz + yz}{100} + \frac{xyz}{(100)^2}\right]\%$$

$$= \left[5 + 10 + 20 + \frac{(5\times10) + (5\times20) + (10\times20)}{100} + \frac{5\times10\times20}{(100)^2}\right]\%$$

$$= \left(35 + \frac{350}{100} + \frac{1000}{(100)^2}\right)$$

$$= (35 + 3.5 + 0.1)\%$$

$$= 38.6\%$$

**Illustration 47:** The sides of a cube are decreased by 10% each. Find out the percentage change in its volume.

**Solution:** Here, $x = y = z$.

$\therefore$ Percentage change in volume

$$= \left[3x + \frac{3x^2}{100} + \frac{x^3}{(100)^2}\right]\%$$

$$= \left[3(-10) + \frac{3(-10)^2}{100} + \frac{(-10)^3}{(100)^2}\right]\%$$

$$= (-30 + 3 - 0.1)\% = -27.1\%$$

–ve sign indicates decrease in volume, that is, there is a decrease in volume by 27.1%

**Illustration 48:** The diameter of a sphere is increased by 20%. What is the percentage increase in its volume?

**Solution:** Percentage increase in volume

$$= \left[3x + \frac{3x^2}{100} + \frac{x^3}{(100)^2}\right]\% \quad [\text{Here, } x = y = z]$$

$$= \left[3\times 20 + \frac{3(20)^2}{100} + \frac{(20)^3}{(100)^2}\right]\%$$

$$= (60 + 12 + 0.8)\% = 72.8\%$$

**Illustration 49:** The radius of a right circular cylinder is decreased by 5%, but its height is increased by 10%. What is the percentage change in its volume?

**Solution:** Here, $x = y = -15$ and $z = 10$.

$\therefore$ Percentage change in volume

$$= \left[-5 - 5 + 10 + \frac{(-5)(-5) + (-5)(10) + (-5)(10)}{100} + \frac{(-5)(-5)(10)}{(100)^2}\right]\%$$

$$= (0 - 0.75 + 0.025)\% = -0.725\%$$

Therefore, volume decrease by 0.725%

**Illustration 50:** Each of the radius and the height of a cone is increased by 25%. Find out the percentage increase in volume.

**Solution:** Here, $x = y = 25$ and $z = 25$.

$\therefore$ Percentage increase in volume

$$= \left[25 + 25 + 25 + \frac{25\times 25 + 25\times 25 \times 25\times 25}{100} + \frac{25\times 25\times 25}{(100)^2}\right]\%$$

$$= (75 + 18.75 + 1.56)\% = 95.3\%$$

2. If the two measuring dimensions which are included in the surface area of a sphere, cuboid, cube, cylinder or cone are increased or decreased by $x$% and $y$%, then the surface area of the figure will increase or decrease by

$$\left(x + y + \frac{xy}{100}\right)\%$$

Note that in case of percentage increase, values of $x$, $y$ and $z$ are positive, and in case of percentage decrease, values of $x$, $y$ and $z$ are negative.

**Illustration 51:** Each edge of a cube is increased by 20%. What is the percentage increase in its surface area?

**Solution:** Here, $x = y = 20$.

$\therefore$ Percentage increase in surface area

$$= \left(x + y + \frac{xy}{100}\right)\%$$

$$= \left(20 + 20 + \frac{20\times 20}{100}\right)\%$$

$$= (40 + 4)\% = 44\%$$

**Illustration 52:** The radius of a hemisphere is decreased by 10%. Find out the percentage change in its surface area.

**Solution:** Here, $x = y = -10$.

$\therefore$ Percentage change in surface area

$$= \left(x + y + \frac{xy}{100}\right)\%$$

$$= \left(-10 - 10 + \frac{(-10)\,(-10)}{100}\right)\%$$

$$= (-20 + 1)\% = -19\%$$

Therefore, surface area of hemisphere decreases by 19%

**Illustration 53:** The radius of a right circular cone is increased by 25% and slant height is decreased by 30%. Find out the percentage change in curved surface area of the cone.

**Solution:** Here, $x = 25$ and $y = -30$.

$\therefore$ Percentage change in curved surface area

$$= \left(x + y + \frac{xy}{100}\right)\%$$

$$= \left[25 - 30 + \frac{(25)(-30)}{100}\right]\%$$

$$= (-5 - 7.5)\% = -12.5\%$$

Therefore, curved surface area decreases by 12.5%

**Illustration 54:** The radius and height of a cylinder are increased by 10% and 20%, respectively. Find out the percentage increase in its surface area.

**Solution:** Here, $x = 10$ and $y = 20$.

$\therefore$ Percentage increase in surface area

$$= \left(x + y + \frac{xy}{100}\right)\%$$

$$= \left(10 + 20 + \frac{10\times 20}{100}\right)\% = 32\%$$

> **3.** If a sphere of radius $R$ is melted to form smaller spheres each of radius $r$, then
>
> The number of smaller spheres
> $$= \frac{\text{Volume of the bigger sphere}}{\text{Volume of the smaller sphere}}$$
> $$= \left(\frac{R}{r}\right)^3.$$

**Illustration 55:** Find out the number of lead balls of radius 1 cm each that can be made from a sphere of radius 4 cm.

**Solution:** Number of lead balls = $\left(\frac{R}{r}\right)^3 = \left(\frac{4}{1}\right)^3 = 64.$

> **4.** If by melting $n$ spheres, each of radius $r$, a big sphere is made, then
>
> Radius of the big sphere = $r \cdot \sqrt[3]{n}.$

**Illustration 56:** If by melting 8 spheres, each of radius 5 cm, a big sphere is made, what will be the radius of the big sphere?

**Solution:** Radius of the big sphere = $r \cdot \sqrt[3]{n}$

$$= 5.\sqrt[3]{8} = 5.2 = 19 \text{ cm.}$$

> **5.** If a cylinder is melted to form smaller spheres each of radius $r$, then
>
> The number of small spheres $= \frac{\text{Volume of cylinder}}{\text{Volume of 1 sphere}}.$

**Illustration 57:** How many bullets can be made out of a loaded cylinder 24 cm high and 5 cm diameter, each bullet being 2 cm in diameter?

**Solution:** Number of bullets = $\frac{\text{Volume of cylinder}}{\text{Volume of 1 sphere}}.$

$$= \frac{\pi \times \frac{5}{2} \times \frac{5}{2} \times 24}{\frac{4}{3} \times \pi \times 1 \times 1 \times 1} = 450.$$

> **6.** If a sphere of radius $r$ is melted and a cone of height $h$ is made, then
>
> Radius of the cone = $2 \times \sqrt{\frac{r^3}{h}}.$
>
> or,
>
> If a cone of height $h$ is melted and a sphere of radius $r$ is made, then
>
> Radius of the cone = $2 \times \sqrt{\frac{r^3}{h}}.$

**Illustration 58:** A solid cone of copper of height 3 cm is melted and a solid sphere of radius 3 cm is made. Then what is the diameter of the base of the cone?

**Solution:** Radius of the base of the cone

$$= 2 \times \sqrt{\frac{r^3}{h}} = 2 \times \sqrt{\frac{3^3}{3}} = 6$$

$\therefore$ Diameter of the base of the cone = 2 × 6

= 12 cm.

**Illustration 59:** If a solid cone of copper of height 2 cm is melted and a solid sphere of radius 2 cm is made, what is the diameter of the base of the cone?

**Solution:** Radius of the base of the cone

$$= 2 \times \sqrt{\frac{r^3}{h}}. = 2 \times \sqrt{\frac{(2)^3}{2}}$$

$$= 2 \times 2 = 4 \text{ cm.}$$

$\therefore$ Diameter of the base of the cone = 2 × 4 = 8 cm.

## EXERCISE-I

**1.** A tank, 16 m long and 23 m wide contains water. How many cubic m of water must be rushed into it to make the surface rise by 16 $\frac{2}{3}$ cm?

(a) 48 $m^3$ (b) 40 $m^3$
(c) 32 $m^3$ (d) 42 $m^3$

**2.** The outer dimensions of a closed box are 12 cm by 10 cm by 8 cm. If the box is made of wood 1 cm thick, find out the capacity of the box.

(a) 360 $cm^3$ (b) 480 $cm^3$
(c) 240 $cm^3$ (d) 560 $cm^3$

**3.** A cistren of dimensions 2.4 m × 2.0 m × 1.5 m takes 2 hours 30 minutes to get filled with water. The rate at which water flows into the cistern is:

(a) 0.48000 cu.m/h (b) 800 cu.m/min
(c) 800 cu.m/sec (d) None of these

**4.** The area of three adjacent faces of a rectangular box are $p$, $q$ and $r$ square cm. The volume of the box is given by:

(a) $(p + q + r)$ cm$^3$ (b) $\sqrt{pqr}$ cm$^3$
(c) $(pqr)^{1/3}$cm$^3$ (d) $pqr$ cm$^3$

**5.** A reservoir, 30 m long, and 15 m broad, is filled with water. How many gallons of water must be taken out to lower the level of water by 4 m?

(a) 342000 gallons (b) 364200 gallons
(c) 324000 gallons (d) 386400 gallons

**6.** How many bricks, each measuring 250 cm by 12.5 cm by 7.5 cm, will be required to build a 5 m long, 3 m high and 20 cm thick wall?

(a) 1480 (b) 1280
(c) 1680 (d) 1480

**7.** Find out the cost of the log of wood measuring 15 $\frac{1}{2}$ m by $2\frac{3}{4}$ m by 1 $\frac{1}{3}$ m at ₹45 per cm$^3$.

(a) ₹4257.50 (b) ₹4005.00
(c) ₹4207.50 (d) ₹4357.50

**8.** How many bricks are required to build a 15 m long 3 m high and 50 cm thick wall, if each brick measures 25 cm by 12 cm by 6 cm.

(a) 16500 (b) 14500
(c) 12500 (d) 10500

**9.** Find the diagonal of a cuboid whose dimensions are 12 m by 10 m by 8 m.

(a) 18 m (b) 17.5 m
(c) 17 m (d) 16.5 m

**10.** The outer dimensions of a closed wooden box of 1 cm thick are 12 cm by 10 cm by 8 cm. Find out the cost of the wood required to make the box if 1 cm$^3$ of wood costs ₹3.00.

(a) ₹1440 (b) ₹1640
(c) ₹1840 (d) ₹2040

**11.** 3 equal cubes are placed adjacently in a row. Find out the ratio of the total surface area of the new cuboid to that of the sum of the surface areas of the three cubes:

(a) 3:5 (b) 4:5
(c) 6:7 (d) 7:9

**12.** The diagonal of a cubical box is $\sqrt{300}$ cm. Find out the surface area:

(a) $600\sqrt{3}$ cm$^2$ (b) 600 cm$^2$
(c) 1200 cm$^2$ (d) $900\sqrt{3}$ cm$^2$

**13.** An iron cube of 10 cm sides is hammered into a rectangular sheet of thickness 0.5 cm. If the sides of the sheet be in the ratio 1:5, the sides (in cm) are:

(a) 110 cm, 50 cm (b) 20 cm, 100 cm
(c) 40 cm, 200 cm (d) None of these

**14.** The length of a room is 12 m, width 8 m, and height 6 m. How many boxes will it hold if each is allowed 1.5 cubic metre of space?

(a) 864 (b) 506
(c) 384 (d) 436

**15.** A 3.3 m high room is half as long again as it is wide and its volume is $123\frac{3}{4}$ m$^3$. Find out its length and breadth.

(a) 7.5 m, 6 m (b) 8 m, 5 m
(c) 7.5 m, 5 m (d) 8.5 m, 5 m

**16.** A tank 3 m long, 2 m wide and 1.5 m deep is dug in a field 22 m long and 14 m wide. If the earth dug out is evenly spread out over the field, the level of the field will rise by nearly:

(a) 0.299 cm (b) 0.29 mm
(c) 2.98 cm (d) 4.15 cm

**17.** A school room is to be built to accommodate 70 children, so as to allow 2.2 m$^2$ of floor and 11 m$^3$ of space for each child. If the room be 14 m long, what must be its breadth and height?

(a) 12 m, 5,5 m (b) 11 m, 5 m
(c) 13 m, 6 m (d) 11 m, 4 m

**18.** If 210 m$^3$ of sand be thrown into a tank 12 m long and 5 m wide, find how much the water will rise?

(a) 3.5 m (b) 4 m
(c) 7 m (d) Data inadequate

**19.** If the length, breadth and height of a rectangular parallelopiped are in the ratio 6:5:4 and if total surface area is 33,300 m$^2$, then the length, breadth and height of parallelopiped (in cm) respectively are:

(a) 90, 85, 600 (b) 90, 75, 70
(c) 85, 75, 60 (d) 90, 75, 60

**20.** A m$^3$ of metal weighing 90 Kg is rolled into a square bar 9 metre long. An exact cube is cut off from the bar. How much does it weigh?

(a) $5\frac{2}{3}$ Kg (b) $6\frac{1}{3}$ Kg
(c) $3\frac{1}{3}$ Kg (d) $4\frac{2}{3}$ Kg

**21.** How many cubes, each of surface 24 cm$^{2,}$ can be made out of a cube of edge measure 1 metre?

(a) 165000 (b) 125000
(c) 180000 (d) 155000

**22.** 3 solid cubes whose edges are 6, 8 and 10 cm respectively, are melted and formed into a single cube. If there be no loss of metal in the process, find out the edge of the new cube.

(a) 16 cm (b) 10 cm
(c) 14 cm (d) 12 cm

**23.** If a cube with its edge 6 cm is melted and smaller cubes with edge 2 cm each are formed, then how many cubesare formed?

(a) 39 (b) 24
(c) 27 (d) 21

**24.** How many small cubical blocks of side 5 cm can be cut from a cubical block whose each edge measures 20 cm?

(a) 56 (b) 48
(c) 64 (d) 52

**25.** Surface area of a cube is 600 $cm^2$. Find out the length of its diagonal.

(a) $15\sqrt{3}$ (b) $12\sqrt{3}$
(c) $10\sqrt{3}$ cm (d) None of these

**26.** A rectangular tank is 30 m long and 20 m broad. Water is being flown into it through a square pipe of side 5 cm. What is the speed of water if the level of water in the tank rises by 1 m in 8 hours?

(a) 30 Km/h (b) 36 Km/h
(c) 40 Km/h (d) None of these

**27.** Calculate the number of bricks, each measuring 25 cm × 15 cm × 8 cm, required to construct a wall with its dimension 19 m × 4 m × 5 m, when 10% of its volume is occupied by mortar.

(a) 4000 (b) 8000
(c) 7000 (d) 6000

**28.** 3 cubes of metal whose edges are in the ratio 3:4:5 are melted into a single cube, the length of whose diagonal is $48\sqrt{3}$ m. Calculate the edges of the three cubes.

(a) 24 m, 32 m, 40 m (b) 40 m, 32 m, 24 m
(c) 30 m, 22 m, 18 m (d) 48 m, 36 m, 24 m

**29.** A cube of lead with edges measuring 6 cm each is melted and recasted into 27 equal cubes. The length of the edge of the new cube is:

(a) 3 cm (b) 4 cm
(c) 2 cm (d) 1.5 cm

**30.** The volume of a cube is 729 $cm^3$. The total surface area of the cube is:

(a) 216 $cm^2$ (b) 384 $cm^2$
(c) 486 $cm^2$ (d) 512 $cm^2$

**31.** 2 cubes have volumes in the ratio 1:27. The ratio of the area of the face of one to that of the other is:

(a) 1:2 (b) 1:3
(c) 1:6 (d) 1:9

**32.** 2 cubes, each of side 12 cm, are joined end-to-end. The surface area of the resulting cuboid is:

(a) 1240 $cm^2$ (b) 1440 $cm^2$
(c) 2250 $cm^2$ (d) 4252 $cm^2$

**33.** The perimeter of one face of a cube is 20 cm. Its volume is:

(a) 1009 $cm^3$ (b) 525 $cm^3$
(c) 320 $cm^3$ (d) 125 $cm^3$

**34.** A cube of edge 3 cm of iron weighs 12 gm. What is the weight of a similar cube of iron whose edge is 12 cm?

(a) 768 gm (b) 678 gm
(c) 964 gm (d) 864 gm

**35.** The weight of a solid cube of iron of 1 cm edge is 17 gm. What should be the weight with a similar cube of edge 3 cm?

(a) 449 gm (b) 459 gm
(c) 469 gm (d) 4390 gm

**36.** A cubic metre of silver weighing 900 Kg is rolled into a 16 m long square bar. Find out the weight of an exact cube cut off from it.

(a) 14 Kg $62\frac{1}{2}$ gm (b) 30 Kg
(c) 10 Kg (d) 7 Kg 50 gm

**37.** A 4 cm cube is cut into 1 cm cubes. What is the ratio of the surface area of small cubes to that of the large cube?

(a) 1:16 (b) 2:3
(c) 4:1 (d) 6:1

**38.** A large cube is formed from the material obtained by melting three smaller cubes of 3, 4 and 5 cm side. What is the ratio of the total surface areas of the smaller cubes and the large cube?

(a) 2:1 (b) 3:2
(c) 25:18 (d) 27:20

**39.** How many small cubes, each of 96 $cm^2$ surface area, can be formed from the material obtained by melting a larger cube with 384 $cm^2$ surface area?

(a) 8 (b) 5
(c) 800 (d) 8000

**40.** A cubical metallic tank whose each edge measures 30 cm, is completely filled with water. If 2,7 litres

water is taken out of it, what will be the depth of the remaining water in the tank?

(a) 37 cm (b) 27 cm
(c) 17 cm (d) None of these

**41.** Find out the weight of a hollow cylindrical lead pipe 28 cm long and $\frac{1}{2}$ cm thick. Its internal diameter is 8 cm. $\left(\text{Weight of 1 cm}^3 \text{ of lead is 11.4 g, } \pi = \frac{22}{7}\right)$

(a) 3.762 Kg (b) 4.562 Kg
(c) 7.462 Kg (d) 6.762 Kg

**42.** Volume of the cylinder is 1650 $m^3$. whereas the surface area of its base is $78\frac{4}{7}$ $m^2$. Find out the height of the cylinder.

(a) 2.1 m (b) 7.5 m
(c) 21 m (d) 14 m

**43.** 1496 $cm^3$ of a metal is used to cast a pipe of length 28 cm. If the internal radius of the pipe is 8 cm, then the outer radius of the pipe is:

(a) 7 cm (b) 9 cm
(c) 10 cm (d) 12 cm

**44.** The base of a of 10 cm high solid cylinder is a semi-circle of radius 7 cm. Its total surface (in $cm^2$) is $\left(\text{Use } \pi = \frac{22}{7}\right)$

(a) 154 (b) 176
(c) 514 (d) None of these

**45.** A sphere is melted to form a cylinder whose height is $4\frac{1}{2}$ times its radius; What is the ratio of radii of sphere to the cylinder?

(a) 3:2 (b) 4:3
(c) 3:5 (d) 2:3

**46.** The radius of a cylinder is the same as that of a sphere. Their volumes are equal. The height of the cylinder is:

(a) 4/3 times its radius. (b)2/3 times its radius.
(c) equal to its radius. (d)equal to its diameter.

**47.** A 12 m deep well with internal diameter 3.5 m is dug up. The earth from it is spread evenly to form a platform 10.5 m by 8.8 m. Determine the height of the platform.

(a) 2.25 m (b) 3.25 m
(c) 1.25 m (d) 4.25 m

**48.** The curved surface of a well is 264 sq m and its capacity is 924 $m^3$. What is the diameter and the depth of the well?

(a) 8 m (b) 9 m
(c) 4.5 m (d) 6 m

**49.** The sum of the radius of the base and the height of a solid cylinder is 37 m. If the total surface area of the cylinder be 1628 $m^2$, find out the volume:

(a) 4620 $m^3$ (b) 4630 $m^3$
(c) 4520 $m^3$ (d) 4830 $m^3$

**50.** A brick measures 20 cm by 10 cm by $7\frac{1}{2}$ cm. How many bricks will be required for constructing a 25 m long, 2 m high and $\frac{3}{4}$ m thick wall?

(a) 25000 (b) 35000
(c) 20000 (d) 45000

**51.** The height of a right circular cylinder is 6 m. 3 times the sum of the areas of its two circular faces is twice the area of its curved surface. The radius of the base is:

(a) 4 m (b) 2 m
(c) 6 m (d) 1.5 m

**52.** The radius of the cylinder is made twice as large. How should the height be changed so that the volume remains the same?

(a) $\frac{1}{2}$ × height of two cylinders

(b) $\frac{1}{4}$ × height of original cylinder

(c) $\frac{1}{4}\pi r^2$

(d) None of these

**53.** A right cylinder and a right circular cone have the same radius and the same volume. The ratio of the height of the cylinder to that of the cone is:

(a) 3:5 (b) 2:5
(c) 3:1 (d) 1:3

**54.** 2 cans have the same height equal to 21 m. One can is cylindrical, the diameter of whose base is 10 cm. The other can has square base of side 10 cm. What is the difference in between their capacities?

(a) 350 $cm^2$ (b) 450 $cm^3$
(c) 250 $cm^2$ (d) None of these

**55.** A roller is 120 cm long and has diameter 84 cm. If it takes 500 complete revolutions to level a play ground, then determine the cost of levelling at the rate of 30 paise per $m^2$. $\left(\text{Use } \pi = \dfrac{22}{7}\right)$

(a) ₹475.40 (b) ₹375.45
(c) ₹375.20 (d) ₹475.20

**56.** The circumference of one end of a frustum of a right circular cone is 48 cm and of the other end is 34 cm. If the height of the frustrum is 10 cm, its volume (in $cm^3$) is:

(a) 5400 (b) 1350
(c) 2700 (d) 4050

**57.** Find out the amount of concrete required to erect a concrete pillar whose circular base will have a perimeter 8.8 m and whose curved surface is 17.6 m. $\left(\pi = \dfrac{22}{7}\right)$

(a) $12\dfrac{4}{25}$ $m^3$ (b) $12\dfrac{3}{25}$ $m^3$

(c) $12\dfrac{1}{2}$ $m^3$ (d) $12\dfrac{8}{25}$ $m^3$

**58.** Sum of the length, width and depth of a cuboid is $s$ and its diagonal is $d$. Its surface area is:

(a) $s^2$ (b) $d^2$
(c) $s^2 - d^2$ (b) $s^2 + d^2$

**59.** A cylindrical tower is 5 m in diameter and 14 m high. The cost of white washing its curved surface at 50 paise per $m^2$ is:

(a) ₹90 (b) ₹97
(c) ₹100 (d) ₹110

**60.** A solid piece of iron of dimensions $49 \times 33 \times 24$ cm is moulded into a sphere, The radius of the sphere is:

(a) 35 cm (b) 21 cm
(c) 29 cm (d) None of these

**61.** How many coins, 2 mm thick and 1.5 cm in diameter, should be melted in order to form a right circular cylinder its base diameter 6 cm and height 8 cm?

(a) 640 (b) 540
(c) 740 (d) 840

**62.** A hemisphere is made of lead. Its of radius is 6 cm; It cast into a right circular cone of 75 cm height. The radius of the base of the cone is:

(a) 1.4 cm (b) 2.4 cm
(c) 1.6 cm (d) 3.2 cm

**63.** A solid cylinder has a total surface area of 231 $cm^2$. Its curved surface area is (2/3) of the total surface area. Find out the volume of the cylinder.

(a) 270 $cm^3$ (b) 269.5 $cm^3$
(c) 256.5 $cm^3$ (d) 289.5 $cm^3$

**64.** It is required to design a circular pipe such that water flowing through it at a speed of 7 m per min fills a tank of capacity 440 cubic m in 10 min. The inner radius of the pipe should be:

(a) 2 m (b) $\sqrt{2}$ m

(c) $\dfrac{1}{2}$ m (d) $\dfrac{1}{\sqrt{2}}$ m

**65.** From a solid right circular cylinder with height 10 cm and radius of the base 6 cm; a right circular cone of the same height and base is removed. The volume (in $cm^3$) of the remaining solid is:

(a) 377 (b) 754.3
(c) 1131 (d) None of these

**66.** The radii of two cylinders are in the ratio 2:3. The ratio their height is 5:3. The ratio of their volume is:

(a) 20:27 (b) 10:9
(c) 18:13 (d) 9:20

**67.** The capacity of a tank, in the form of a cylinder, is 6160 $m^3$. If the diameter of its base is 28 m, find out the cost of painting its inner curved surface at the rate of ₹2.8 per $m^2$. $\left(\text{Use } \pi = \dfrac{22}{7}\right)$

(a) 2464 (b) 2664
(c) 3064 (d) 2864

**68.** The sum of the radius of the base and the height of a solid cylinder is 37 m. If the total surface area of the solid cylinder is 1628 $m^2$, then the circumference of its base and the volume of the cylinder are:

(a) 68 m; 7875 $m^3$ (b) 52 m; 5825 $m^3$
(c) 44 m; 4620 $m^3$ (d) 30 m; 3859 $m^3$

**69.** A rectangular piece of paper is 22 cm long and 10 cm wide. A cylinder is formed by rolling the paper along its length. The volume of the cylinder is:

(a) $225\pi$ $cm^3$ (b) 385 $cm^3$
(c) $25\pi$ $cm^3$ (d) None of these

**70.** The ratio of total surface area to lateral surface area of a cylinder whose radius is 80 cm and height 20 cm, is:

(a) 2:1 (b) 3:1
(c) 4:1 (d) 5:1

**71.** A right cylindrical vessel is full with water. How many right cones having the same diameter and height as those of right cylinder will be needed to store that water?

(a) 2 (b) 3
(c) 4 (d) 5

**72.** A cylindrical bucket is 72 cm high and 29 cm in diameter and is full of water. This water is emptied in a rectangular tank whose length and breadth are 66 cm and 28 cm, respectively. What will be the height of the water level in the tank?

(a) 36 cm (b) 48 cm
(c) 24 cm (d) 22 cm

**73.** A cylindrical iron rod is 70 cm long. The diameter of its end portion is 2 cm. What is its weight, reckoning a $cm^3$ of iron to weigh 10 grams?

(a) 4 Kg (b) 4.2 Kg
(c) 2.2 Kg (d) Data inadequate

**74.** If the radius of a cylinder is doubled and the height is halved, then what would be ratio between the new curved surface area and the previous curved surface area of the cylinder:

(a) 1:1 (b) 2:1
(c) 3:2 (d) 2:3

**75.** A cylindrical jar of diameter 24 cm contains water to a height of 30 cm. A spherical steel ball is dropped into the jar and the level of the water rises by 67.5 mm. The diameter of the ball is:

(a) 16 cm (b) 15 cm
(c) 20 cm (d) 18 cm

**76.** The material of a solid cone is converted into the shape of solid cylinder of equal radius. If the height of the cylinder is 5 cm, then what is the height of the cone?

(a) 25 cm (b) 15 cm
(c) 20 cm (d) 10 cm

**77.** The volume of solid cylinder whose diameter of the base is 14 mm and length 25 mm is 3850 $mm^3$. If length of the cylinder is doubled, but the diameter is halved, then what will be the volume of the resulting cylinder?

(a) 1172 $mm^3$ (b) 1925 $mm^3$
(c) 3850 $mm^3$ (d) 7700 $mm^3$
(e) None of these

**78.** A monument has 50 cylindrical pillars each of diameter 50 cm and height 4 m. What will be the labour charges for cleaning these pillars at the rate of 50 paise per $m^2$? (Use $\pi = 3.14$):

(a) ₹237 (b) ₹257
(c) ₹157 (d) ₹353

**79.** The radius of a cylinder is made twice large. How should the height be changed, so that its volume remains unchanged?

(a) $\frac{1}{4}$ of original (b) $\frac{1}{3}$ of original
(c) $\frac{1}{2}$ of original (d) $\frac{1}{8}$ of original

**80.** A spherical ball of lead, 3 cm in diameter, is melted and re-cast into three spherical balls. The diameter of 2 of these are 1.5 cm and 2 cm, respectively. The diameter of the third ball is:

(a) 2.66 cm (b) 2.5 cm
(c) 3 cm (d) 3.5 cm

**81.** A cone and a cylinder having the same area of the base have also the same area of curved surfaces. If the height of cylinder be 2 m, find out the slant height of the cone:

(a) 3 m (b) 3.5 m
(c) 4.5 m (d) 4 m

**82.** The radii of a cylinder and a cone are equal. If the height of the cylinder is equal to the slant height of the cone then the ratio of the curved surfaces of the cylinder and the cone is:

(a) 1:1 (b) 2:1
(c) 3:1 (d) 4:1

**83.** From a cubical block of wood of side 1 m, a cylinder of the largest possible volume is curved out. The volume (in $m^3$) of the remaining wood is:

(a) $\frac{3}{14}$ (b) $\frac{5}{14}$
(c) $\frac{1}{2}$ (d) $\frac{2}{7}$

**84.** The radius of the base of a solid cylinder is $r$ cm and its height is 3 cm. It is re-casted into a cone of same radius, the height of the cone will be:

(a) 3 cm (b) 6 cm
(c) 9 cm (d) 27 cm

**85.** 2 cm of rain has fallen on a $Km^2$ of land. Assuming that 50% of the raindrops could have been collected and contained in a pool having a 100 m × 10 m base, by what level would the water level in the pool have increased?

(a) 15 m (b) 20 m
(c) 10 m (d) 25 m

**86.** The perpendicular height of a conical tent is $4\frac{2}{3}$ m and the diameter of its base is 6 m. If 11 persons can sleep in this tent, find how many average cu m of air each person gets?

(a) 2 cu m (b) 4 cu m
(c) 6 cu m (d) 8 cu m

**87.** The circumference of the base of a 9 m high conical tent is 44 m. The volume of the air contained in it is:

(a) 462 $m^3$ (b) 452 $m^3$
(c) 472 $m^3$ (d) 512 $m^3$

**88.** A conical vessel of base radius 2 cm and height 3 cm is filled with kerosene. This liquid leaks through a hole in the bottom and collects in a cylindrical jar of radius 2 cm. The kerosene level in the jar is:

(a) 1.5 cm (b) $\pi$ cm
(c) 1 cm (d) 3 cm

**89.** A hollow cylinder of height 3 cm, is re-casted into a solid cylinder. If the external and internal radii of the hollow cylinder are 4.3 cm and 1.1 cm, respectively. What will be the radius of the solid cylinder?

(a) 2.8 cm (b) 2.4 cm
(c) 3.2 cm (d) 4.8 cm

**90.** A solid consists of a circular cylinder with an exact fitting right circular cone placed on the top. The height of the cone is $h$. If the total volume of the solid is three times the volume of the cone, then the height of the cylinder is:

(a) $2h$ (b) $4h$
(c) $\frac{2h}{3}$ (d) $\frac{3h}{3}$

**91.** A well of 11.2 m diameter is dug 8 m deep. The earth taken out has been spread all around it to a width of 7 cm to form a circular embankment. Find out the height of the embankment.

(a) 304.8 $m^2$ (b) 400.4 $m^2$
(c) 408.4 $m^2$ (d) 412.4 $m^2$

**92.** The curved surface of a circular cylinder of height $h$ and the slant surface of the cone of slant height '$2h$' having the same circular base are in the ratio of:

(a) 1:1 (b) 1:2
(c) 3:2 (d) 1:3

**93.** The material of a cone is converted into the shape of a cylinder of equal radius. If the height of the cylinder is 5 cm, the height of the cone is:

(a) 10 cm (b) 15 cm
(c) 18 cm (d) 24 cm

**94.** A right circular cone is exactly fitted inside a cube in such a way that the edges of the base of the cone are touching the edges of one of the faces of the cube and the vertex is on the opposite face of the cube. If the volume of the cube is 343 c.c, then what approximately is the volume of the cone?

(a) 90 c.c. (b) 75 c.c.
(c) 80 c.c. (d) 85 c.c.

**95.** A solid cone is 25 cm high and the radius of its base is 50 cm. It is melted and re-cast into a solid sphere. Determine the surface area of the sphere.

(a) 8757.28 $cm^2$ (b) 5877.42 $cm^2$
(c) 7857.14 $cm^2$ (d) None of these

**96.** The radius and height of right circular cone are in the ratio 5:12. If its volume is $314\frac{3}{7}m^3$. Find out the radius of the cone.

(a) 5 m (b) 8 m
(c) 12 m (d) 6 m

**97.** A cone, a hemisphere and a cylinder stand on equal bases and have the same height. The ratio of their volumes are:

(a) 1:2:2 (b) 1:2:3
(c) 1:2:4 (d) 2:3:4

**98.** Find out the length of the canvas 2 m in width required to make a conical tent 12 m in diameter and 6.3 m in slant height:

(a) 118.8 m (b) 62.4 m
(c) 59.4 m (d) 112.4 m

**99.** The radius of a cylinder is doubled and the height is halved, what is the ratio between the new volume and the previous volume?

(a) 3:1 (b) 2:3
(c) 2:1 (d) 1:3

**100.** A circus tent is cylindrical to a height of 3 m and conical above it. If its diameter is 105 m and slant height of the conical portion is 53 m, then calculate the length of the canvas 5 m wide to make the tent.

(a) 1857 m (b) 1647 m
(c) 1947 m (d) 1847 m

**101.** If base radius of a cone is increased by 20% and its slant height is doubled, then by how much per cent will the area of its curved surface be increased?

(a) 140% (b) 160%
(c) 130% (d) 180%

**102.** The radius of the base of conical tent is 5 cm. If the tent is 12 m high, then area of the canvas required in making the tent is:

(a) 60 $\pi$ m$^2$ (b) 300 $\pi$ m$^2$
(c) 90 $\pi$ m$^2$ (d) None of these

**103.** A cone of height 7 cm and base radius 3 cm is carved from a rectangular block of wood 10 cm $\times$ 5 cm $\times$ 2 cm. The percentage % wood wasted is:

(a) 34% (b) 46%
(c) 54% (d) 66%

**104.** The diameter and slant height of a conical tomb are 28 m and 50 m, respectively. The cost of white washing its curved surface at the rate of 80 paise per m$^2$ is:

(a) ₹2640 (b) ₹1760
(c) ₹264 (d) ₹176
(e) None of these

**105.** A rectangular sheet of area 264 cm$^2$ and width 11 cm is rolled along its breadth to make a hollow cylinder. The volume of the cylinder is:

(a) 231 c.c. (b) 230 c.c.
(c) 235 c.c. (d) 234 c.c.

**106.** A cylinder and a cone have their heights in the ratio 2:3 and the radii of their bases in the ratio 3:4. Find out the ratio of their volumes.

(a) 1:9 (b) 2:9
(c) 9:8 (d) 1:8

**107.** If the height of a cone is doubled, then its volume is increased by:

(a) 100% (b) 200%
(c) 300% (d) 400%

**108.** 3 cubes of side 3, 4 and 5, respectively, are melted to form into new cube. The side of the new cube is:

(a) 5 cm (b) 6 cm
(c) 6.5 cm (d) 7 cm

**109.** The height and base radius of a cone are each increased by 100%. The volume of the cone now becomes:

(a) double the original.
(b) 4 times the original.
(c) 3 times the original.
(d) 8 times the original.

**110.** If the radius of a sphere is doubled, then its volume is increased by:

(a) 100% (b) 200%
(c) 700% (d) 800%

**111.** The diameter of a sphere is 6 cm. It is melted and drawn into a wire of diameter 0.2 cm. Find out the length of the wire.

(a) 24 m (b) 28 m
(c) 36 m (d) 32 m

**112.** A cone-shaped circular tent is 9 m high and the circumference of its circular base is 44 m. How much air is contained in the tent? $\left(\text{Use } \pi = \dfrac{22}{7}\right)$

(a) 362 m$^3$ (b) 462 m$^3$
(c) 562 m$^3$ (d) 662 m$^3$

**113.** If the radius of a sphere is doubled, then its surface area is increased by:

(a) 100% (b) 200%
(c) 300% (d) 50%

**114.** The height of a cylinder is decreased by 8%, keeping its radius unchanged. What is the percentage change in its volume?

(a) 8% increase (b) 12% decrease
(c) 8% decrease (d) None of these

**115.** The radius of a cylinder is increased by 20%, keeping its height unchanged. What is the percentage increase in its volume?

(a) 33% (b) 44%
(c) 22% (d) None of these

## EXERCISE-2
## (BASED ON MEMORY)

**1.** A hemisphere and a cone have equal bases. If their heights are also equal, then the ratio of their curved surfaces will be:

(a) $1:\sqrt{2}$ (b) $\sqrt{2}:1$
(c) 1:2 (d) 2:1

**[SSC (GL) Prel. Examination, 2005]**

**2.** The curved surface of a cylindrical pillar is 264 $m^2$ and its volume is 924 $m^3$. The ratio of its diameter to its height is [use $\pi = \frac{22}{7}$]

(a) 7:6 (b) 6:7
(c) 3:7 (d) 7:3

**[SSC (GL) Prel. Examination, 2005]**

**3.** The base radii of two cylinders are in the ratio 2:3, and their heights are in the ratio 5:3. The ratio of their volumes is:

(a) 27:20 (b) 20:27
(c) 9:4 (d) 4:9

**[SSC (GL) Prel. Examination, 2005]**

**4.** A cuboidal water tank contains 216 litres of water. Its depth is $\frac{1}{3}$ of its length and breadth is $\frac{1}{2}$ of $\frac{1}{3}$ of the difference between the length and the depth. The length of the tank is:

(a) 72 dm (b) 18 dm
(c) 6 dm (d) 2 dm

**[SSC (GL) Prel. Examination, 2005]**

**5.** 12 spheres of the same size are made by melting a solid cylinder of 16 cm diameter and 2 cm height. The diameter of each sphere is:

(a) 2 cm (b) 4 cm
(c) 3 cm (d) $\sqrt{3}$ cm

**[SSC (GL) Prel. Examination, 2005]**

**6.** A rectangular paper 11 cm by 8 cm can be exactly wrapped to cover the curved surface of a cylinder of height 8 cm. The volume of the cylinder is:

(a) 6 $cm^3$ (b) 77 $cm^3$
(c) 88 $cm^3$ (d) 121 $cm^3$

**[SSC (GL) Prel. Examination, 2000]**

**7.** The volumes of two spheres are in the ratio 8:27. The ratio of their surface areas is:

(a) 4:9 (b) 2:3
(c) 4:5 (d) 5:6

**[SSC (GL) Prel. Examination, 2000]**

**8.** How many cubes, each of edge 3 cm, can be cut to form a cube of edge 15 cm?

(a) 25 (b) 27
(c) 125 (d) 144

**[SSC (GL) Prel. Examination, 2000]**

**9.** If the volumes of 2 cubes are in the ratio 27:64, then the ratio of their total surface areas is:

(a) 27:64 (b) 3:4
(c) 9:16 (d) 3:8

**[SSC (GL) Prel. Examination, 2000]**

**10.** The base radii of two cylinders are in the ratio 2:3 and their heights are in the ratio 5:3. The ratio of their volumes is:

(a) 27:20 (b) 20:27
(c) 9:4 (d) 4:9

**[SSC (GL) Prel. Examination, 2000]**

**11.** The slant height of a conical mountain is 2.5 Km and the area of its base is 1.54 $Km^2$. Find out the height.

(a) 2.2 Km (b) 2.4 Km
(c) 3 Km (d) 3.11 Km

**[SSC (GL) Prel. Examination, 2000]**

**12.** A hemisphere and a cone have equal bases. If their heights are also equal, the ratio of their curved surfaces will be:

(a) $1:\sqrt{2}$ (b) $\sqrt{2}:1$
(c) 1:2 (d) 2:1

**[SSC (GL) Prel. Examination, 2000]**

**13.** Three solid metallic spheres of diameters 6 cm, 8 cm and 10 cm are melted and recast into a new solid sphere. The diameter of the new sphere is:

(a) 4 cm (b) 6 cm
(c) 8 cm (d) 12 cm

**[SSC (GL) Prel. Examination, 2000]**

**14.** The base of a conical tent is 19.2 m in diameter and the height of its vertex is 2.8 m. The area of the canvas required to put up such a tent (in $m^2$) $\left(\text{taking } \pi = \frac{22}{7}\right)$ is nearly:

(a) 3017.1 (b) 3170
(c) 301.7 (d) 30.17

**[SSC (GL) Prel. Examination, 2000]**

**15.** A cone of height 7 cm and base radius 1 cm is carved from a cuboidal block of wood 10 cm × 5 cm × 2 cm. Assuming $\pi = \frac{22}{7}$, the percentage wood wasted in the process is:

(a) $92\frac{2}{3}\%$ (b) $46\frac{1}{3}\%$
(c) $53\frac{2}{3}\%$ (d) $7\frac{1}{3}\%$

**[SSC (GL) Prel. Examination, 2000]**

**16.** Three solid metallic balls of radii 3 cm, 4 cm and 5 cm are melted and mounted into a single solid ball. The radius of the new ball is:

(a) 2 cm (b) 3 cm
(c) 4 cm (d) 6 cm

**[SSC (GL) Prel. Examination, 2000]**

**17.** The volume of a cuboid is twice the volume of a cube. If the dimensions of the cuboid are 9 cm, 8 cm and 6 cm the total surface area of the cube is:

(a) 72 $cm^2$ (b) 216 $cm^2$
(c) 432 $cm^2$ (d) 108 $cm^2$

**[SSC (GL) Prel. Examination, 2002]**

**18.** The curved surface of a cylindrical pillar is 264 $m^2$ and its volume is 924 $m^2$. Taking $\pi = \frac{22}{7}$, find out the ratio of its diameter to its height:

(a) 7:6 (b) 6:7
(c) 3:7 (d) 7:3

**[SSC (GL) Prel. Examination, 2002]**

**19.** A room is 6 m long, 5 m broad and 4 m high. The maximum length of the rod that can be kept in the room is:

(a) $\sqrt{61}$ m (b) $\sqrt{16}$ m
(c) $\sqrt{36}$ m (d) $\sqrt{77}$ m

**20.** The number of coins of radius 0.75 cm and thickness 0.2 cm to be melted to make a right circular cylinder of height 8 cm and base radius 3 cm is:

(a) 640 (b) 460
(c) 500 (d) 600

**[SSC (GL) Prel. Examination, 2002]**

**21.** The area of the base of a right circular cone is 154 $cm^2$ and its height is 14 cm. Taking $\pi = \frac{22}{7}$, the curved surface of the cone is:

(a) $(154 \times \sqrt{5})$ $cm^2$ (b) $(154 \times \sqrt{5})$ $cm^2$
(c) 11 $cm^2$ (d) 5324 $cm^2$

**[SSC (GL) Prel. Examination, 2002]**

**22.** If the areas of the three adjacent faces of a cuboidal box are 120 $cm^2$, 72 $cm^2$ and 60 $cm^2$, respectively, then find the volume of box:

(a) 7200 $cm^3$ (b) 720 $cm^3$
(c) 864 $cm^3$ (d) $(72)^2$ $cm^3$

**[SSC (GL) Prel. Examination, 2002]**

**23.** If a right circular cone of height 24 cm has a volume of 1232 $cm^3$, then the area of its curved surface is $\left(\text{Use } \pi = \frac{22}{7}\right)$

(a) 1254 $cm^2$ (b) 794 $cm^2$
(c) 550 $cm^2$ (d) 154 $cm^2$

**[SC (GL) Prel. Examination, 2002]**

**24.** Spheres *A* and *B* have their radii 40 cm and 10 cm, respectively. Ratio of surface area of *A* to the surface area of *B* is:

(a) 1:16 (b) 4:1
(c) 1:4 (d) 16:1

**25.** A cylindrical tube, open at both ends, is made of metal. The internal diameter of the tube is 11.2 cm and its length is 21 cm. The metal everywhere is 0.4 cm thick. The volume of the metal is $\left(\text{Use } \pi = \frac{22}{7}\right)$

(a) 316 $cm^3$ (b) 310 $cm^3$
(c) 306.24 $cm^3$ (d) 280.52 $cm^3$

**[SSC (GL) Prel. Examination, 2003]**

**26.** A wooden box measures 20 cm by 12 cm by 10 cm. Thickness of wood is 1 cm. Volume of wood to make the box (in cubic cm) is:

(a) 960 (b) 519
(c) 2400 (d) 1120

**[SSC (GL) Prel. Examination, 2003]**

**27.** A 20 cm long hollow cylindrical tube is made of iron and its external and internal diameters are 8 cm and 6 cm, respectively. The volume of iron used in making the tube is $\left(\text{Use } \pi = \frac{22}{7}\right)$

(a) 1760 $cm^3$ (b) 880 $cm^3$
(c) 440 $cm^3$ (d) 220 $cm^3$

**[SSC (GL) Prel. Examination, 2003]**

**28.** The area of a side of a box is 120 $cm^2$. The area of the other side of the box is 72 $cm^2$. If the area of the upper surface of the box is 60 $cm^2$, find the volume of the box.

(a) 259200 $cm^3$ (b) 86400 $cm^3$
(c) 720 $cm^3$ (d) Cannot be determined
(d) None of these

**[BSRB Bangalor PO Examination, 2000]**

**29.** Water is flowing at the rate of 5 Km/h through a pipe of diameter 14 cm into a rectangular tank which is 50 m long, 44 m wide. The time taken, in hours, for the rise in the level of water in the tank to be 7 cm is:

(a) 2 (b) $1\frac{1}{2}$
(c) 3 (d) $2\frac{1}{2}$

**[SSC (GL) Examination, 2011]**

**30.** The areas of three consecutive faces of a cuboid are 12 $cm^2$, 20 $cm^2$ and 15 $cm^2$, then the volume (in $cm^3$) of the cuboid is:

(a) 3600 (b) 100
(c) 80 (d) 60

**[SSC (GL) Examination, 2011]**

**31.** Water is flowing at the rate of 3 Km/h through a circular pipe of 20 cm internal diameter into a circular cistern of diameter 10 m and depth 2 m. In how much time will the cistern be filled?

(a) 1 hour (b) 1 hour 40 mins
(c) 1 hours 20 mins (d) 2 hours 40 mins

**[SSC (GL) Examination, 2011]**

**32.** Marbles of diameter 1.4 cm are dropped into a cylindrical beaker containing some water and are fully submerged. The diameter of the beaker is 7 cm. Find how many marbles have been dropped in it if the water rises by 5.6 cm.

(a) 50 (b) 150
(c) 250 (d) 350

**[SSC (GL) Examination, 2011]**

**33.** A hemisphere and a cone have equal bases. If their heights are also equal, the ratio of their curved surfaces will be:

(a) $1:\sqrt{2}$ (b) $2:\sqrt{2}$
(c) 1:2 (d) 2:1

**[SSC (GL) Examination, 2011]**

**34.** If the side of a cube is increased by 100%, its volume is increased by:

(a) 400% (b) 800%
(c) 200% (d) 100%

**[UPPCS Examination, 2012]**

**35.** The height of a cone is 30 cm. A small cone is cut off at the top by a plane parallel to the base. If its volume be $\frac{1}{27}$th of the volume of the given cone, at what height above the base is the section made?

(a) 19 cm (b) 20 cm
(c) 12 cm (d) 15 cm

**[SSC Examination, 2014]**

**36.** If the surface area of a sphere is 346.5 $cm^2$, then its radius is $\left[\text{taking } \pi = \frac{22}{7}\right]$

(a) 7 cm (b) 3.25 cm
(c) 5.25 cm (d) 9 cm

**[SSC Examination, 2014]**

**37.** The height of the right pyramid whose area of the base is 30 $m^2$ and volume is 500 $m^3$, is:

(a) 50 m (b) 60 m
(c) 40 m (d) 20 m

**[SSC Examination, 2014]**

**38.** The base of a prism is a right-angled triangle with 2 sides 5 cm and 12 cm. The height of the prism is 10 cm. The total surface area of the prism is :

(a) 360 $cm^2$ (b) 300 $cm^2$
(c) 330 $cm^2$ (d) 325 $cm^2$

**[SSC Examination, 2014]**

**39.** The base of a right prism is an equilateral triangle. If the lateral surface area and volume is 120 $cm^2$ and $40\sqrt{3}\ cm^3$, respectively, then the side of base of the prism is:

(a) 4 cm (b) 5 cm
(c) 7 cm (d) 40 cm

**[SSC Examination, 2014]**

**40.** A ball of lead, 4 cm in diameter, is covered with gold. If the volume of the gold and lead are equal, then the thickness of gold is approximately [given $\sqrt[3]{2} = 1.259$]

(a) 5.038 cm (b) 5.190 cm
(c) 1.038 cm (d) 0.518 cm

**[SSC Examination, 2014]**

**41.** A large solid sphere is melted and moulded to form identical right circular cones with base radius and height same as the radius of the sphere. One of these cones is melted and moulded to form a smaller solid sphere. Then the ratio of the surface area of the smaller to the surface area of the larger sphere is:

(a) $1:3^{\frac{4}{3}}$ (b) $1:2^{\frac{3}{2}}$

(c) $1:3^{\frac{2}{3}}$ (d) $1:2^{\frac{4}{3}}$

**[SSC Examination, 2014]**

**42.** A conical cup is filled with ice cream. The ice cream forms a hemispherical shape on its open top. The height of the hemispherical part is 7 cm. The radius of the hemispherical part equals the height of the cone. Then the volume of the ice cream is $\left[\pi = \frac{22}{7}\right]$

(a) 1078 $m^3$ (b) 1708 $m^3$

(c) 7108 $m^3$ (d) 7180 $m^3$

**[SSC Examination, 2014]**

**43.** If each side of a cube is increased by 10%, the volume of the cube will increase by:

(a) 30% (b) 10%

(c) 33.1% (d) 25%

**[SSC Examination, 2014]**

**44.** A right circular cone is 3.6 cm high and radius of its base is 1.6 cm. It is melted and recast into a right circular cone with radius of its base as 1.2 cm. Then the height of the cone (in cm) is:

(a) 3.6 (b) 4.8

(c) 6.4 (d) 7.2

**[SSC Examination, 2013]**

**45.** If h, c, v are respectively the height, curved surface area and volume of a right circular cone, then the value of $3\pi vh^3 - c^2h^2 + 9v^2$ is:

(a) 2 (b) −1

(c) 1 (d) 0

**[SSC Examination, 2013]**

**46.** The volume of a conical tent is 1232 cu m and the area of its base is 154 $m^2$. Find the length of the canvas required to build the tent, if the canvas is 2 m in width. $\left(\text{Take } \pi = \frac{22}{7}\right)$

(a) 270 m (b)272 m

(c) 276 m (d)275 m

**[SSC Examination, 2013]**

**47.** Assume that a drop of water is spherical and its diameter is $\frac{1}{10}$ of a centimetre. A conical glass has a height equal to the diameter of its rim. If 32,000 drops of water fill the glass completely, then the height of the glass (in cm) is:

(a) 1 (b) 2

(c) 3 (d) 4

**[SSC Examination, 2013]**

**48.** The total number of spherical bullets, each of diameter 5 decimetre, that can be made by utilizing the maximum of a rectangular block of lead with 11 m length, 10 m breadth and 5 m width is (assume that $\pi$>3):

(a) Equal to 8800 (b) Less than 8800

(c) Equal to 8400 (d) Greater than 9000

**[SSC Examination, 2013]**

**49.** A rectangular block of metal has dimensions 21 cm, 77 cm and 24 cm. The block has been melted into a sphere. The radius of the sphere is $\left(\text{Take } \pi = \frac{22}{7}\right)$

(a) 21 cm (b) 7 cm

(c) 14 cm (d) 28 cm

**[SSC Examination, 2013]**

**50.** If a right circular cone of height 24 cm has a volume of 1232 $cm^3$, then the area (in $cm^2$) of curved surface is:

(a) 550 (b) 704

(c) 924 (d) 1254

**[SSC Examination, 2013]**

**51.** If each edge of a cube is increased by 50%, the percentage increase in surface area is:

(a) 125% (b) 50%

(c) 100% (d) 75%

**[SSC Examination, 2013]**

**52.** If the surface areas of two spheres are in the ratio 4:9, then the ratio of their volumes will be:

(a) 4:9 (b) 16:27

(c) 8:27 (d) 16:9

**[SSC Examination, 2013]**

**53.** If each edge of a cube is increased by 50%, the percentage increase in its surface area is:

(a) 150% (b) 75%

(c) 100% (d) 125%

**[SSC Assistant Grade III, 2013]**

**54.** The diameter of a copper sphere is 18 cm. The sphere is melted and is drawn into a long wire of uniform circular cross-section. If the length of the wire is 108 m, the diameter of the wire is:

(a) 1 cm (b) 0.9 cm

(c) 0.3 cm (d) 0.6 cm

**[SSC Assistant Grade III, 2013]**

**55.** A semicircular sheet of metal of diameter 28 cm is bent into an open conical cup. The capacity of the cup $\left(\text{taking } \pi = \frac{22}{7}\right)$ is:

(a) 624.26 $cm^3$ (b) 622.36 $cm^3$
(c) 622.56 $cm^3$ (d) 623.20 $cm^3$

**[SSC Assistant Grade III, 2013]**

**56.** If surface area and volume of a sphere are $S$ and $V$, respectively, then value of $\frac{S^3}{V^3}$ is:

(a) $36\pi$ (b) $9\pi$
(c) $18\pi$ (d) $27\pi$

**[SSC Assistant Grade III, 2013]**

**57.** A solid sphere of radius 1 cm is melted to convert into a wire of length 100 cm. The radius of the wire (using $\sqrt{3} = 1.732$) is:

(a) 0.08 cm (b) 0.09 cm
(c) 0.16 cm (d) 0.11 cm

**[SSC Assistant Grade III, 2012]**

**58.** A field is in the form of a rectangle of length 18 m and width 15 m. A pit, 7.5 m long, 6 m broad and 0.8 m deep, is dug in a corner of the field and the earth taken out is evenly spread over the remaining area of the field. The level of the field raised is:

(a) 12 cm (b) 14 cm
(c) 16 cm (d) 18 cm

**[SSC Assistant Grade III, 2012]**

**59.** The base of a right pyramid is an equilateral triangle of side 4 cm. The height of the pyramid is half of its slant height. Its volume is:

(a) $\frac{8}{9}\sqrt{2}$ $cm^3$ (b) $\frac{7}{9}\sqrt{3}$ $cm^3$

(c) $\frac{8}{9}\sqrt{3}$ $cm^3$ (d) $\frac{7}{9}\sqrt{2}$ $cm^3$

**[SSC Assistant Grade III, 2012]**

**60.** Water flows in a tank $150 \text{ m} \times 100 \text{ m}$ at the base, through a pipe whose cross-section is 2 dm by 1.5 dm, at the speed of 15 Km/h. In what time will the water be 3 m deep?

(a) 100 hours (b) 120 hours
(c) 140 hours (d) 150 hours

**[SSC Assistant Grade III, 2012]**

**61.** A tent is of the shape of a right circular cylinder upto a height of 3 m and then becomes a right circular cone with maximum height of 13.5 m above the ground. If the radius of the base is 14 m, the cost of painting the inner side of the tent at the rate of ₹2 per $m^2$ is:

(a) ₹2,050 (b) ₹2,060
(c) ₹2,068 (d) ₹2,080

**[SSC Assistant Grade III, 2012]**

**62.** If the diameter of a sphere is decreased by 25%, its curved surface area will be decreased by:

(a) 43.25% (b) 43.50%
(c) 43.75% (d) 44.25%

**[SSC Assistant Grade III, 2012]**

**63.** The radius of a cylinder is 10 cm and height is 4 cm. The number of centim that may be added either to the radius or to the height to get the same increase in the volume of the cylinder is:

(a) 5 (b) 4
(c) 25 (d) 16

**[SSC Examination, 2012]**

**64.** If a solid cone of volume 27 $\pi$ $cm^3$ is kept inside a hollow cylinder whose radius and height are that of the cone, then the volume of water needed to the empty space is:

(a) $3\pi$ $cm^3$ (b) $18\pi$ $cm^3$
(c) $54\pi$ $cm^3$ (d) $81\pi$ $cm^3$

**[SSC Examination, 2012]**

**65.** Two cm of rain has fallen on a square Km of land. Assuming that 50% of the raindrops could have been collected and contained in a pool having a 100 m × 10 m base, by what level would he water level in the pool have increased?

(a) 1 Km (b) 10 m
(c) 10 cm (d) 1 m

**[SSC Examination, 2012]**

**66.** A cylindrical can whose base horizontal and is of internal radius 3.5 cm contains sufficient water so that when a solid sphere is placed inside, water just covers the sphere. The sphere fits in the can exactly. The depth of water in the can before the sphere was put is:

(a) $\frac{35}{3}$ cm (b) $\frac{17}{3}$ cm

(c) $\frac{7}{3}$ cm (d) $\frac{14}{3}$ cm

**[SSC Examination, 2012]**

**67.** The height of a circular cylinder is increased 6 times and the base area is decreased to $\frac{1}{9}$ of its value. The factor by which the lateral surface of the cylinder increases is:

(a) 2 (b) $\frac{1}{2}$

(c) $\frac{2}{3}$ (d) $\frac{3}{2}$

**[SSC Examination, 2012]**

**68.** The volume of a right circular cone is 1232 $cm^3$ and its vertical height is 24 cm. Its curved surface area is:

(a) 154 $cm^2$ (b) 550 $cm^2$
(c) 604 $cm^2$ (d) 704 $cm^2$

**[SSC Examination, 2012]**

**69.** The height of a right prism with a square base is 15 cm. If the area of the total surfaces of the prism is 608 $cm^2$, its volume is:

(a) 910 $cm^2$ (b) 920 $cm^2$
(c) 960 $cm^2$ (d) 980 $cm^2$

**[SSC Examination, 2012]**

**70.** The volume of a solid hemisphere is 19404 $cm^3$. Its total surface area is:

(a) 4158 $cm^3$ (b) 2858 $cm^3$
(c) 1738 $cm^3$ (d) 2038 $cm^3$

**[SSC Examination, 2012]**

**71.** The heights of a cone, cylinder and hemisphere are equal. If their radii are in the ratio 2:3:1, then the ratio of their volumes is:

(a) 2:9:2 (b) 4:9:1
(c) 4:27:2 (d) 2:3:1

**[SSC Examination, 2011]**

**72.** Base of a right pyramid is a square, length of diagonal of the base is $24\sqrt{2}$ m. If the volume of the pyramid is 1728 cu. m, its height is:

(a) 7 m (b) 8 m
(c) 9 m (d) 10 m

**[SSC Examination, 2011]**

**73.** The height of a right circular cone and the radius of its circular base are 9 cm and 3 cm respectively. The cone is cut by a plane parallel to its base so as to divide it into two parts. The volume of the frustum (i.e., the lower part) of the cone is 44 $cm^2$. The radius of the upper circular surface of the frustum $\left(\text{taking } \pi = \frac{22}{7}\right)$ is:

(a) $\sqrt[3]{12}$ cm (b) $\sqrt[3]{13}$ cm
(c) $\sqrt[3]{6}$ cm (d) $\sqrt[3]{20}$ cm

**[SSC Examination, 2011]**

**74.** The ratio of radii of 2 right circular cylinders is 2:3 and their heights are in the ratio 5:4. The ratio of their curved surface area is:

(a) 5:6 (b) 3:4
(c) 4:5 (d) 2:3

**[SSC Examination, 2011]**

**75.** A solid cylinder has total surface area of 462 sq.cm. Curved surface area is $\frac{1}{3}$rd of its total surface area. The volume of the cylinder is:

(a) 530 $cm^2$ (b) 536 $cm^2$
(c) 539 $cm^2$ (d) 545 $cm^2$

**[SSC Examination, 2011]**

**76.** A cylinder and a cone have equal radii of their bases and equal heights. If their curved surface areas are in the ratio 8:5, the ratio of their radius and height is:

(a) 1:2 (b) 1:3
(c) 2:3 (d) 3:4

**[SSC Examination, 2011]**

**77.** A solid is hemispherical at the bottom and conical above. If the surface areas of the two parts are equal, then the ratio of radius and height of its conical part is:

(a) 1:3 (b) 1:1
(c) 3:1 (d) $1:\sqrt{3}$

**[SSC Examination, 2011]**

**78.** Base of a right prism is an equilateral triangle of side 6 cm. If the volume of the prism is $108\sqrt{3}$ cc, its height is:

(a) 9 cm (b) 10 cm
(c) 11 cm (d) 12 cm

**[SSC Examination, 2011]**

**79.** The number of coins, each of radius 0.75 cm and thickness 0.2 cm, to be melted to make a right circular cylinder of height 8 cm and radius 3 cm, is:

(a) 640 (b) 600
(c) 500 (d) 480

**[SSC Examination, 2010]**

**80.** If the radius of a sphere is increased by 2 m, its surface area is increased by 704 $m^2$. What isthe radius of the original sphere? $\left(\text{use } \pi = \frac{22}{7}\right)$

(a) 16 $m^2$ (b) 15 $m^2$
(c) 14 $m^2$ (d) 13 $m^2$

**[SSC Examination, 2010]**

**81.** A right circular cylinderis circumscribing a hemisphere such that their bases are common. The ratio of their volumes is.

(a) 1:3 (b) 1:2
(c) 2:3 (d) 3:4

**[SSC Examination, 2010]**

**82.** 3 spherical balls of radii 1 cm, 2 cm and 3 cm are melted to form a single spherical ball. In the process, the loss of material is 25%. The radius of the new ball is:

(a) 6 cm (b) 5 cm
(c) 3 cm (d) 2 cm

**[SSC Examination, 2010]**

**83.** The length of the diagonal of a cube is 6 cm. The volume of the cube (in cm$^3$) is:

(a) $18\sqrt{3}$ (b) $24\sqrt{3}$

(c) $28\sqrt{3}$ (d) $30\sqrt{3}$

**[SSC Examination, 2010]**

**84.** If a sphere of radius r is divided into 4 identical parts, then the total surface area of the 4 parts is:

(a) $4\pi r^2$ square units
(b) $2\pi r^2$ square units
(c) $8\pi r^2$ square units
(d) $3\pi r^2$ square units

**[SSC Examination, 2010]**

**85.** A rectangular plot, 36 m long and 28 m broad, has two concrete roads 5 m wide running in the middle of the park,one parallel to the length and the other parallel to the breadth. What would be the total cost of gravelling the plot, excluding the area covered by the roads, at ₹3.60 per m$^2$?

(a) ₹2772.20 (b) ₹2466.60
(c) ₹2654.40 (d) ₹2332.60
(e) ₹2566.80

**[IBPS PO/MT Examination, 2014]**

**86.** The edge of an ice cube is 14 cm. The volume of the largest cylindrical ice cube that can be formed out of it is

(a) 2200 cm$^3$ (b) 2000 cm$^3$
(c) 2156 cm$^3$ (d) 2400 cm$^3$
(e) None of these

**[IBPS PO/MT Examination, 2013]**

**Directions (Q. 87–91):** Study the following information and answer the questions that follow:
The premises of a bank are to be renovated. The renovation is in terms of flooring. Certain areas are to be floored either with marble or wood. All rooms/halls and pantry are rectangular. The area to be renovated comprises a hall for customer transaction measuring 23 m by 29 m, the branch manager's room measuring 13 m by 17 m, a pantry measuring 14 m by 13 m, a record keeping-cum-server room measuring 21 m by 13 m and locker area measuring 29 m by 21 m. The total area of the bank is 2000 m$^2$. The cost of wooden flooring is ₹170 per m$^2$ and the cost of marble flooring is ₹190 per sm$^2$. The locker area, record keeping-cum-server room and pantry are to be floored with marble. The branch manager's room and hall for customer transaction are to be floored with wood. No other area is to be renovated in terms of flooring.

**87.** What is the ratio of the total cost of wooden flooring to the total cost of marble flooring?

(a) 1879:2527
(b) 1887:2386
(c) 1887:2527
(d) 1829:2527
(e) 1887:2351

**[IBPS PO/MT Examination, 2012]**

**88.** If the 4 walls and ceiling of the branch manager's room (the height of the room is 12 m) are to be painted at the cost of ₹190 per m$^2$, how much will be the total cost of renovation of the branch manager's room, including the cost of flooring?

(a) ₹1,36,800 (b) ₹2,16,660
(c) ₹1,78,790 (d) ₹2,11,940
(e) None of these

**[IBPS PO/MT Examination, 2012]**

**89.** If the remaining area of the bank is to be carpeted at the rate of ₹110 per m$^2$, how much will be the increment in the total cost of renovation of bank premises?

(a) ₹5,820 (b) ₹4,848
(c) ₹3,689 (d) ₹6,690
(e) None of these

**[IBPS PO/MT Examination, 2012]**

**90.** What is the percentage area of the bank that is not to be renovated?

(a) 2.2% (b) 2.4%
(c) 4.2% (d) 4.4%
(e) None of these

**[IBPS PO/MT Examination, 2012]**

**91.** What is the total cost of renovation of the hall for customer transaction and the locker area?

(a) ₹2,29,100 (b) ₹2,30,206
(c) ₹2,16,920 (d) ₹2,42,440
(e) None of these

**[IBPS PO/MT, 2012]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (b) | **3.** (c) | **4.** (b) | **5.** (c) | **6.** (b) | **7.** (c) | **8.** (c) | **9.** (b) | **10.** (a) | **11.** (d) | **12.** (b) |
| **13.** (b) | **14.** (c) | **15.** (c) | **16.** (c) | **17.** (b) | **18.** (a) | **19.** (d) | **20.** (c) | **21.** (b) | **22.** (d) | **23.** (c) | **24.** (c) |
| **25.** (c) | **26.** (a) | **27.** (d) | **28.** (a) | **29.** (c) | **30.** (c) | **31.** (d) | **32.** (b) | **33.** (d) | **34.** (a) | **35.** (b) | **36.** (a) |
| **37.** (a) | **38.** (d) | **39.** (d) | **40.** (b) | **41.** (a) | **42.** (c) | **43.** (b) | **44.** (c) | **45.** (a) | **46.** (a) | **47.** (c) | **48.** (d) |
| **49.** (a) | **50.** (a) | **51.** (a) | **52.** (b) | **53.** (d) | **54.** (b) | **55.** (d) | **56.** (b) | **57.** (d) | **58.** (c) | **59.** (d) | **60.** (b) |
| **61.** (a) | **62.** (b) | **63.** (b) | **64.** (b) | **65.** (b) | **66.** (a) | **67.** (a) | **68.** (c) | **69.** (b) | **70.** (d) | **71.** (b) | **72.** (c) |
| **73.** (c) | **74.** (a) | **75.** (d) | **76.** (b) | **77.** (b) | **78.** (c) | **79.** (a) | **80.** (b) | **81.** (d) | **82.** (b) | **83.** (a) | **84.** (c) |
| **85.** (c) | **86.** (b) | **87.** (a) | **88.** (c) | **89.** (b) | **90.** (c) | **91.** (b) | **92.** (a) | **93.** (b) | **94.** (a) | **95.** (c) | **96.** (a) |
| **97.** (b) | **98.** (c) | **99.** (c) | **100.** (c) | **101.** (a) | **102.** (d) | **103.** (a) | **104.** (b) | **105.** (a) | **106.** (c) | **107.** (a) | **108.** (b) |
| **109.** (d) | **110.** (c) | **111.** (c) | **112.** (b) | **113.** (c) | **114.** (c) | **115.** (b) | | | | | |

### Exercise-2

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (d) | **2.** (d) | **3.** (b) | **4.** (b) | **5.** (b) | **6.** (b) | **7.** (b) | **8.** (c) | **9.** (c) | **10.** (b) | **11.** (b) | **12.** (b) |
| **13.** (d) | **14.** (c) | **15.** (a) | **16.** (d) | **17.** (b) | **18.** (d) | **19.** (d) | **20.** (a) | **21.** (a) | **22.** (b) | **23.** (c) | **24.** (d) |
| **25.** (c) | **26.** (a) | **27.** (c) | **28.** (c) | **29.** (a) | **30.** (d) | **31.** (b) | **32.** (b) | **33.** (b) | **34.** (d) | **35.** (b) | **36.** (c) |
| **37.** (a) | **38.** (c) | **39.** (a) | **40.** (d) | **41.** (d) | **42.** (a) | **43.** (c) | **44.** (c) | **45.** (d) | **46.** (d) | **47.** (d) | **48.** (a) |
| **49.** (a) | **50.** (a) | **51.** (a) | **52.** (c) | **53.** (d) | **54.** (d) | **55.** (b) | **56.** (a) | **57.** (d) | **58.** (c) | **59.** (c) | **60.** (a) |
| **61.** (c) | **62.** (c) | **63.** (a) | **64.** (c) | **65.** (b) | **66.** (c) | **67.** (a) | **68.** (b) | **69.** (c) | **70.** (a) | **71.** (c) | **72.** (c) |
| **73.** (b) | **74.** (a) | **75.** (c) | **76.** (d) | **77.** (d) | **78.** (d) | **79.** (a) | **80.** (d) | **81.** (c) | **82.** (c) | **83.** (b) | **84.** (c) |
| **85.** (e) | **86.** (c) | **87.** (c) | **88.** (e) | **89.** (e) | **90.** (b) | **91.** (a) | | | | | |

## EXPLANATORY ANSWERS

### Exercise-1

**1.** **(c)** Volume of water $= 16 \times 12 \times \dfrac{16\frac{2}{3}}{100}$ m$^3$

$= 16 \times 12 \times \dfrac{50}{3 \times 100}$ m$^3$

$= 32$ m$^3$.

**2.** **(b)** Since the wood is 1 cm thick, the inner measurements are

$l$ = 12 cm − 2 cm = 10 cm

$b$ = 10 cm − 2 cm = 8 cm

$h$ = 8 cm − 2 cm = 6 cm

Capacity of the box $= l \times b \times h$

= 10 cm × 8 cm × 6 cm

= 480 cm$^3$.

**3.** **(c)** Volume of the cistern = 2.4 × 2 × 1.5 m$^3$

= 7.2 m$^3$

Time taken = 2.5 hours

$\therefore$ Rate of water flow $= \dfrac{7.2}{2.5}$ m$^3$/hours

$= \dfrac{7.2 \times 100 \times 100 \times 100}{2.5 \times 60 \times 60}$

= 800 m$^3$/sec.

4. **(b)** Let, the sides of the box be $x$, $y$ and $z$.
Then, $p = xy$, $q = yz$, $r = zx$
Volume of the box = $xyz$
We have, $p \times q \times r = xy \times yz \times zx = x^2y^2z^2$
or, $xyz = \sqrt{pqr}$.

5. **(c)** Volume of water lowered = 30 × 15 × 4 m$^3$ = 1800 m$^3$
$\therefore$ Number of gallons taken out
= 1800 × 180 gallons
= 324000 gallons
[1 m$^3$ of water = 180 gallons]

6. **(b)** Number of bricks
$= \dfrac{\text{Volume of the wall}}{\text{Volume of the brick}}$
$= \dfrac{(5\times100)\times(3\times100)\times20}{25\times12.5\times7.5} = 1280.$

7. **(c)** Volume of the wood $= \dfrac{31}{2}\times\dfrac{11}{4}\times\dfrac{4}{3}$ m$^3$ = 93.5 m$^3$
Cost of the wood = ₹45 × 93.5 = ₹4207.50.

8. **(c)** Number of bricks
$= \dfrac{\text{Volume of the wall}}{\text{Volume of the brick}}$
$= \dfrac{1500\text{ cm}\times300\text{ cm}\times50\text{ cm}}{12\text{ cm}\times12\text{ cm}\times6\text{ cm}} = 12500$

9. **(b)** Length of the diagonal
$= \sqrt{12^2+10^2+8^2}\,\text{m}$
$= \sqrt{308}\,\text{m}$
= 17.5 m

10. **(a)** External dimensions
$l$ = 12 cm, $b$ = 10 cm, $h$ = 8 cm
External volume = 12 cm × 10 cm × 8 cm
= 960 cm$^3$
Internal dimensions
$l$ = 12 − 2 = 10 cm
$b$ = 10 − 2 = 8 cm
$h$ = 8 − 2 = 6 cm
Internal volume = 10 cm × 8 cm × 6 cm
= 480 cm$^3$
Volume of the wood = 960 cm$^3$ − 480 cm$^3$
= 480 cm$^3$
Cost of the wood = ₹(480 × 3) = ₹1440.

11. **(d)** Let, the side of the cube be $x$ units
$\therefore$ Surface area of cube = $6x^2$
$\therefore$ Sum of the areas of three cubes = $18x^2$
For the cuboid, length = $3x$ units
Breadth = $x$ units
height = $x$ units
$\therefore$ Surface area = 2 [$lb + bh + hl$]
= 2 [$3x \times x + x \times x + x \times 3x$]
= 2 ($7x^2$) = $14x^2$
$\therefore$ $\dfrac{\text{Surface area of new cuboid}}{\text{Total surface area of three cubes}}$
$= \dfrac{14x^2}{18x^2} = \dfrac{7}{9}$.

13. **(b)** Let, the sides be $x$, $5x$.
Cubic cm of iron sheet = $0.5 \times x \times 5x = 2.5x^2$
This should be the volume of the cube
$\therefore$ $2.5x^2$ = 10 × 10 × 10
$x^2 = \dfrac{1000\times10}{25}$
$\therefore$ $x$ = 20 $\therefore$ Sides are 20, 100 cm.

14. **(c)** Capacity of the room = 12 × 8 × 6 cm$^3$
The required number of boxes $= \dfrac{12\times8\times6}{1.5} = 384.$

15. **(c)** Length $= \dfrac{3}{2}$ × breadth; height $= 3\dfrac{3}{10}$ m $\dfrac{3}{2}$ × breadth × breadth × $\dfrac{33}{10} = 123\dfrac{3}{4}$ m$^3$ or, (breadth)$^2$
$= \dfrac{445}{5}\times\dfrac{2}{3}\times\dfrac{10}{33} = 25$ m$^2$.
$\therefore$ Breadth $= \sqrt{25} = 5$ m
$\therefore$ Length $= \dfrac{3}{5}\times5 = 7.5$ m

16. **(c)** Volume of earth dug out = (3 × 2 × 1.5) m$^3$ = 9 m$^3$
Area over which earth is spread
= [(22 × 141) − (3 × 2)] m$^2$ = 302 m$^2$
$\therefore$ Increase in level $= \dfrac{9}{302}$ m $= \dfrac{9\times100}{302}$ cm
= 2.98 cm.

17. **(b)** 14 × $b$ = 70 × 2.2
$\therefore$ $b = \dfrac{70\times2.2}{14} = 11$ m
and $l \times b \times h$ = 70 × 11
$\therefore$ $h = \dfrac{70\times11}{l\times b} = \dfrac{70\times11}{70\times2.2} = 5$ m.

18. **(a)** Let, the initial height be $h$ and the height after sand is thrown be $H$ m.
We have to find out $H - h$.
According to question,
12 × 5 × ($H - h$) = 210
$\therefore$ $H - h = \dfrac{210}{60} = \dfrac{7}{2} = 3.5$ m.

19. **(d)** Let, the length, breadth and height be $6x$, $5x$ and $4x$ m, respectively.
Then, 2 × [$6x \times 5x + 4x \times 5x + 4x \times 6x$] = 33300
$\therefore$ $148x^2$ = 33300.

or, $x^2 = 225$ or, $x = 15$
So, length = 90 m
breadth = 75 m
height = 60 m.

**20.** **(c)** (Area of the square end) × 9 = Volume = 1 $m^3$

$\therefore$ Side of the square end = $\sqrt{\frac{1}{9}}$ m = $\frac{1}{3}$ m

$\therefore$ Volume of this cube = $\left(\frac{1}{3}\right)^3$ $m^3$ = $\frac{1}{27}$ $m^3$

$\therefore$ Weight of this cube = $\frac{1}{27} \times 90$ Kg = $3\frac{1}{3}$ Kg.

**21.** **(b)** $6e^2 = 24$ $cm^2$, so that $e$ (edge) = 2 cm

$\therefore$ Number of such cubes out of a cube of edge 1 m (or 100 cm)

$= \left(\frac{100}{2}\right)^3 = 125000.$

**22.** **(d)** Side of the new cube

$= \sqrt[3]{\text{Sum of the cubes of sides of all the cubes}}$

$\therefore$ Side = $\sqrt[3]{6^3 + 8^3 + 10^3} = \sqrt[3]{216 + 512 + 1000}$

$= \sqrt[3]{1728} = 12$ cm.

**23.** **(c)** Number of cubes

$= \left(\frac{\text{Original length of edge}}{\text{New length of edge}}\right)^3$

$\therefore$ Number of cubes = $\left(\frac{6}{2}\right)^3 = 27.$

**24.** **(c)** Volume of the cube with side 20 cm sides = $(20)^3$ = 8000 $cm^3$

Volume of the cube of sides 5 cm = 125 $cm^3$

$\therefore$ Number of smaller cubes of 5 cm sides = $\frac{8000}{125}$ = 64.

**25.** **(c)** Surface area of a cube = 6 × $(\text{side})^2$

$\therefore$ $6 \times (\text{side})^2 = 600$

$\Rightarrow (\text{Sides})^2 = 100$

$\Rightarrow$ Side = $\sqrt{100}$ = 10 cm

$\therefore$ Diagonal of the cube = $\sqrt{3}$ × side

$= \sqrt{3} \times 10 = 10\sqrt{3}$ cm.

**26.** **(a)** Volume of water collected in the tank in 8 hours

= 30 m × 20 m × 1 m

= 600 $cm^3$.

$\therefore$ Volume of water collected in the tank in 1 hour

$= \frac{600}{8} = 75$ $cm^3$.

Water comes through a pipe of cross–section

= 5 cm × 5 cm = $\frac{25}{10000}$ $m^2$.

The speed of water = Distance travelled by the water in the pipe in one hour

$= \frac{75 \times 10000}{25}$ m = 30 Km/h.

**27.** **(d)** Volume of the wall = $10 \times \frac{4}{10} \times 5$

= 20 $m^3$.

Volume of the mortar = $\frac{10}{100} \times 20$ = 2 $cm^3$.

Hence, the volume occupied by the bricks

= 20 − 2 = 18 $m^3$

Volume of each brick = $\frac{25}{100} \times \frac{15}{100} \times \frac{8}{100}$ $m^3$.

$= \frac{3}{1000}$ $m^3$.

Therefore, the required number of bricks

$= 18 \div \frac{3}{1000} = 6000.$

**28.** **(a)** Since the edges of the cubes are in the ratio 3:4:5, let these be $3k$, $4k$, $5k$ m, respectively.

Their volumes are 27 $k^3$, 64 $k^3$, 125 $k^3$ $m^3$.

Thus, the volume of the single cube

= (27 + 64 + 125) $k^3$ $m^3$

= 216 $k^3$ = $(6k)^3$ $m^3$

We know that the length of the diagonal of a cube with side $x$ is $\sqrt{3}\,x$. Therefore, the length of the diagonal of the single cube mentioned in the equestion is equal to $6k\sqrt{3}$. But, the length of the diagonal of this cube is given to be $48\sqrt{3}$, hence

$6k\sqrt{3} = 48\sqrt{3}$, or, $k = 8$.

Therefore, the length of the edges of the three cubes are 3 × 8, 4 × 8, 5 × 8 m, that is, 24 m, 32 m, 40 m.

**29.** **(c)** Edge of the cube = 6 cm.

$\therefore$ Volume of lead = $6^3$ $cm^3$ = 216 $cm^3$.

Let, the edge of the new cube be $x$ cm.

Then, $27x^3 = 216$

$\Rightarrow x^3 = 8$ or, $x = 2$ cm.

**30.** **(c)** Length of the cube = $(729)^{1/3} = 9$

Total surface area = 6 × $(9)^2$ = 486 $cm^2$.

**31.** **(d)** $a^3_1 : a^3_2 = 1:27$

$\Rightarrow$ $a_1 : a_2 = 1:3$

$\therefore$ Required ratio is $1^2:3^2 = 1:9$.

**32.** **(b)** 4 (24 × 12) + 2 (12 × 12) = 1440 $cm^2$.

**33.** **(d)** $4a = 20$ $\Rightarrow$ $a = 5$

$\therefore$ Volume = $a^3 = 5^3 = 125$ $cm^3$.

**34.** **(a)** Ratio of the edge of cubes

= 3:12 = 1:4

Ratio of their volumes = $1^3:4^3$ = 1:64.

Because volume of the new cube is 64 times the volume of the first cube, the weight of the new cube is also 64 times the weight of the first cube.

Weight of the new cube

= 64 × 12 gm = 768 gm

**35.** **(b)** When edge is increased 3 times, the volume or weight is increased $3^3$, i.e., 27 times.

∴ The weight of the other cube

= 27 × 17 = 459 gm.

**36.** **(a)** Let, $x$ be the side of the base of the 16 m long square bar.

∴ $16 \times x^2 = 1$

or, $x^2 = \frac{1}{16}$ or, $x = \frac{1}{4}$ m

Volume of the cube of edge $\frac{1}{4}$ m = $\frac{1}{16}$ $m^3$

Now, 1 $m^3$ weighs 900 Kg

∴ $\frac{1}{16}$ $m^3$ weighs $\frac{900}{64}$ Kg = 14 Kg $62\frac{1}{2}$ gm.

**38.** **(c)** Sum of the surface areas of three smaller cubes

$= 6 \times 3^2 + 6 \times 4^2 + 6 \times 5^2$

= 300 $cm^2$.

Volume of large cube = $3^3 + 4^3 + 5^3$ = 216 $cm^3$.

∴ The edge of large cube = 6 cm.

∴ The surface area of large cube = $6 \times 6^2$ = 216 $cm^2$.

Total surface area of smaller cubes: surface area of large cube

= 300:216 = 25:18.

**39.** **(d)** The edge of the small cube = $\sqrt{\frac{96}{6}}$ = 4 m.

The edge of the large cube = $\sqrt{\frac{384}{6}}$ = 8 cm.

The number of small cubes $= \dfrac{8 \times 8 \times 8}{\frac{4}{10} \times \frac{4}{10} \times \frac{4}{10}} = 8000.$

**40.** **(b)** Volume of the cubical metallic tank

$= l \times b \times h$

= 30 × 30 × 30

= 27000 $cm^3$

∴ Volume of water in the tank $= \frac{27000}{1000}$.

= 27 litre [∵1 litre = 100 $cm^3$]

∴ Volume of remaining water

= 24.3 litre = 243000 $cm^3$

Now, $l \times b \times h$ = 243000

⇒ $30 \times 30 \times h = 243000$ ⇒ $h$ = 27 cm.

**41.** **(a)** External radius of the pipe = $\frac{8}{4}$ = 4 cm.

External volume = $\pi r^2 h$

$= \frac{22}{7} \times 4 \times 4 \times 28$

= 1408 $cm^3$

Internal diameter = 8 − 1 = 7 cm

Internal radius = $\frac{7}{2}$ = 3.5 cm

Internal volume = $\pi r^2 h$

$= \frac{22}{7} \times 3.5 \times 3.5 \times 28$

= 1078 $cm^3$.

Weight of lead = 330 × 11.4 = 3762 g = 3.762 Kg.

**42.** **(c)** Height of the cylinder

$= \dfrac{\text{Volume of cylinder}}{\text{Base Area}}$

$= \dfrac{1650}{78\frac{4}{7}}$ = 21 m.

**43.** **(b)** Let, the outer radius be $x$ cm.

Then, we have

$1496 = \pi \times (28) \times (x^2 - 8^2)$

⇒ $x^2 - 8^2 = \dfrac{1496 \times 7}{22 \times 28} = 17$

or, $x^2 = 17 + 64 = 81$

∴ $x$ = 9 cm.

**44.** **(c)** Curved surface area = $\pi rh$

$= \frac{22}{7} \times 7 \times 10$ = 220 $cm^2$.

Total area of plane faces

$= \dfrac{\pi r^2}{2} + \dfrac{\pi r^2}{2} + 2r \times h$

$= \frac{22}{7} \times 7^2 + 2 \times 7 \times 10$

= 154 + 140 = 294 $cm^2$.

Total surface area

= 220 + 294 = 514 $cm^2$.

**45.** **(a)** Let, the radius of the sphere and cylinder be '$R$' and '$r$', respectively

Volume of the cylinder

$= \pi r^2 h = \pi r^2 \left(\frac{9}{2} r\right) \left(\because h = \frac{9}{2} r\right)$

$= \frac{9}{2} \pi r^3$

Volume of the sphere = $\frac{4}{3} \pi R^3$.

As per the given equestion:

Volume of the sphere = Volume of the cylinder

or, $\frac{4}{3}\pi R^3 = \frac{9}{2}\pi r^3$

or, $\left(\frac{R}{r}\right)^3 = \frac{27}{8}$

$\therefore$ $\frac{R}{r} = \frac{3}{2}$.

**46. (a)** $\frac{4}{3}\pi r^3 = \pi r^2 h \Rightarrow h = \frac{4}{3}r$.

**47. (c)** Volume of the earth dug

= Volume of the well

$= \pi r^2 h = \frac{22}{7}\times\frac{3.5}{2}\times\frac{2.5}{2}\times 12$

$= \frac{231}{2}$ cm$^3$

Area of the platform

= 10.5 m × 8.8 m

= 92.4 m$^2$

Height of the platform $= \frac{231}{2}\times\frac{1}{92.4} = 1.25$ m.

**48. (d)** Let, $r$ and $h$ be the radius and depth of the well, respectively, then

Curved surface $= 2\pi rh = 264$ m$^{2.}$ …(1)

Volume $= \pi r^2 h = 924$ m$^3$.

$\Rightarrow \frac{\pi r^2 h}{2\pi rh} = \frac{924}{264}$

or, $r = \frac{2\times 924}{264} = 7$ m

$\therefore$ Diameter = 14 m

$\therefore$ from Equation (1), we get

$2\pi \times 7 \times h = 264$

or, $h = \frac{264}{14\times\pi} = \frac{264\times 7}{14\times 22} = 6$ m.

**49. (a)** $r + h = 37$ and $2\pi r\,(r + h) = 1628$

or, $\pi r = \frac{1628}{74} = 22$

$\therefore$ $r = 7$ cm and $h = 37 - 7 = 30$ m

$\therefore$ Volume $= \pi r^2 h = \frac{22}{7}\times 7\times 7\times 30$

$= 4620$ m$^3$.

**50. (a)** Volume of the wall $= 25 \times 2 \times \frac{3}{4}$ m$^3$.

Volume of a brick $= \frac{20}{100}\times\frac{10}{100}\times\frac{15}{200}$

$= \frac{3}{2000}$ m$^3$.

The required number of bricks

$= \left(25\times 2\times\frac{3}{4}\right)\div\frac{3}{2000} = 25000$.

**51. (a)** $3 \times 2\pi r^2 = 2 \times 2\pi r \times 6$

$\therefore$ $r = 4$ m.

**52. (b)** $r \to 2r$, $h \to \frac{1}{4}h$, then:

Volume $= \pi (2r)^2 \times \frac{1}{4}h = \pi r^2 h$.

**53. (d)** Let, the height of the cylinder = $h$.

Then, $\pi r^2 h = \frac{1}{3}\pi r^2 H$

or, $\frac{h}{H} = \frac{1}{3}$ = 1:3.

**54. (b)** The volume of cylindrical can $= \pi r^2 h$

$= \frac{22}{7}\times\left(\frac{10}{2}\right)^2\times 21\,\text{cm}^3$

= 1650 cm$^3$

Volume of the square can = (side)$^2 \times h$

= $(10)^2 \times 21$ cm$^3$ = 2100 cm$^3$

Difference in the capacities of the two cans

= (2100 − 1650) cm$^3$ = 450 cm$^3$.

**55. (d)** $r = \frac{84}{2}$ cm $= \frac{21}{50}$ m,

$h = 120$ cm $= \frac{120}{100}$ m $= \frac{6}{5}$ m

The levelled area in one revolution of the roller

= curved surface $= 2\pi rh$

$= 2 \times \frac{22}{7}\times\frac{21}{50}\times\frac{6}{5}$

$= \frac{396}{125}$ m$^2$.

The levelled area in 500 revolutions

$= \frac{396}{125}\times 500 = 1584$ m$^2$.

The required cost of levelling $= \frac{30}{100}\times 1584$

= ₹475.20.

**56. (b)** The radii of ends of the frustum are $\frac{48}{2\pi}, \frac{34}{2\pi}$

$\therefore$ Volume $= \frac{\pi}{3}\times 10\left\{\frac{48\times 48}{(2\pi)^2}+\frac{34\times 34}{(2\pi)^2}+\frac{48\times 34}{(2\pi)^2}\right\}$

$= \frac{10\pi}{3}$ {2304 + 1156 + 1632}

$= \frac{10\times 7\times 5092}{22\times 12}$

= 1350.

**57. (d)** $2\pi r = 8.8$ m

$2\pi rh = 17.6$ m

$\therefore$ $h = 2$ m, $r = 1.4$

Amount of concrete = volume

$= \pi r^2 h$

$$= \left(\frac{22}{7}\times\frac{14}{10}\times\frac{14}{10}\times 2\right)$$

$$= 12\ \frac{8}{25}\ \text{m}^3.$$

**58.** **(c)** $l + b + h = s$ and $\sqrt{l^2 + b^2 + h^2} = d$

So, $l^2 + b^2 + h^2 = d^2$

$\therefore\ (l + b + h)^2 = s^2$

$\Rightarrow\ l^2 + b^2 + h^2 + 2\ (lb + bh + hl) = s^2$

$\Rightarrow\ d^2 + 2\ (lb + bh + hl) = s^2$

$\Rightarrow\ 2\ (lb + bh + hl) = s^2 - d^2$

$\therefore$ Surface area $= s^2 - d^2$.

**59.** **(d)** Curved surface $= 2\pi rh$

$$= 2 \times \frac{22}{7}\times\frac{5}{2}\times 14 = 220\ \text{m}^2$$

Cost for white washing $= ₹\left(220\times\frac{1}{2}\right) = ₹110$.

**60.** **(b)** Let, $r$ be the radius

$\frac{4}{3}\pi r^3 = 49 \times 33 \times 24$

$r^3 = \frac{3\times 7^2\times 3\times 11\times 2^3\times 3\times 7}{2^2\times 2\times 11} = 3^3 \times 7^3$

$\therefore\ r = 3 \times 7 = 21$ cm.

**61.** **(a)** Radius of the coin $= r = \frac{1.5}{2} = \frac{3}{4}$ cm.

Thickness of the coin $= h = 2$ mm $= \frac{1}{5}$ cm

$\therefore$ Volume of one cone $= \pi r^2h = \pi \times \left(\frac{3}{4}\right)^2 \times \frac{1}{5}$.

$$= \frac{9\pi}{80}\ \text{m}^3$$

Radius of the cylinder $= R = 3$ cm.

Height of the cylinder $= H = 8$ cm.

$\therefore$ Volume of the cylinder $= \pi R^2H = 72\pi$ cm$^3$.

Number of coins $= \frac{\text{Volume of the cylinder}}{\text{Volume of the coin}}$

$$= \frac{72\pi}{\pi/80} = 72 \times \frac{80}{9} = 640.$$

**62.** **(b)** Let, $r$ cm be the radius of base of the cone

$\frac{2}{3}\pi\ (6)^3 = \frac{1}{3}\pi r^2 \times 75$

$\therefore\ r^2 = \frac{2\times 216}{75} = \frac{2\times 72}{25}$

$\therefore\ r = \frac{12}{5} = 2.4$ cm.

**63.** **(b)** $2\pi rh + 2\pi r^2 = 231$

and $2\pi rh = \frac{2}{3}\times 231 = 154$

or, $2\pi r^2 = 77$ or, $\pi r^2 = \frac{22}{7}$

$\therefore\ r = \sqrt{\frac{77}{2}\times\frac{7}{22}} = \frac{7}{2}$ cm

Now, $2\times\frac{22}{7}\times\frac{7}{2}\times h = 154$

$\therefore\ h = 7$ cm.

$\therefore$ Volume $= \pi r^2h = \frac{22}{7}\times\frac{7}{2}\times\frac{7}{2}\times 7$

$$= 269.5\ \text{cm}^3.$$

**64.** **(b)** Volume of the water to pass through pipe in 1 min

$= \frac{440}{10} = 44$ cm$^3$.

As the speed of the water is 7 m per min, Volume of the water per min is

$V = \pi r^2 \times 7$, where $r$ is the inner radius of the pipe.

$\therefore\ 44 = \frac{22}{7}\times r^2\times 7 \ \Rightarrow\ r^2 = 2$, or, $r = \sqrt{2}$ m.

**65.** **(b)** Required volume

= Volume of cylinder − Volume of cone

$= \pi \times 6^2 \times 10 - \frac{1}{3}\times\pi\times 6^2\times 10$

$= \frac{2}{3}\times\pi\times 36\times 10$

$= \frac{2}{3}\times\frac{22}{7}\times 360 = \frac{5280}{7}$

$= 754.3$ cm$^3$.

**66.** **(a)** $r = 2x$, $r_1 = 3x$

$h = 5y$, $h_1 = 3y$

Volume ratio $= \pi r^2h{:}\pi r_1^{\,2}h_1$

$= \pi \times (2x)^2 \times 5y{:}\pi \times (3x)^2 \times 3y$

$= 20\pi x^2y{:}27\pi x^2y$

$= 20{:}27$.

**67.** **(a)** Radius of the base of the cylinder

$= r = 14$ m.

$h$ = Depth of the tank

Capacity = Volume of the tank

$= \pi r^2h = 6160$ m$^3$.

or, $\frac{22}{7}\times 14\times 14\times h = 6160 \quad \therefore\ h = 10$ m.

$T$ surface area $= 2\pi rh = 2 \times \frac{22}{7}\times 14\times 10$

$$= 880\ \text{m}^2$$

$\therefore$ Cost of painting this curved surface

$= 880 \times 2.80 = ₹2464$.

**68.** **(c)** $(h + r) = 37$, $2\pi r\ (h + r) = 1628$

$\Rightarrow\ 2\pi r\ (37) = 1628 \ \Rightarrow\ r = \frac{1628\times 7}{2\times 22\times 37} = 7$

$\Rightarrow\ r = 7$ and $h = 30$

$\therefore$ Circumference $= 2\pi r = 2 \times \frac{22}{7}\times 7 = 44$ m.

**69.** **(b)** Rolled along with its length, then $h$ = 10 cm, and the other side = 22 cm.

$\therefore \quad V = \dfrac{10 \times (22)^2 \times 7}{4 \times 22} = 385 \text{ cm}^2.$

**70.** **(d)** $\dfrac{\text{Total surface area}}{\text{Lateral surface area}} = \dfrac{2\pi r h + 2\pi r^2}{2\pi rh}$

$= \dfrac{2\pi r(h+r)}{2\pi rh} = \dfrac{h+r}{h} = \dfrac{20+80}{20} = \dfrac{5}{1} = 5{:}1.$

**71.** **(b)** Let, $x$ cones be needed

Then, $\dfrac{1}{3}\pi r^2 h \times x = \pi r^2 h$, or, $x = 3$.

**72.** **(c)** Radius of the bucket = $r$ = 14 cm

Height of the bucket = $h$ = 72 cm

Volume of the water = Volume of the bucket

$= : \pi r^2 h = \dfrac{22}{7} \times 14 \times 14 \times 72$

$\therefore \quad 66 \times 28 \times H = \dfrac{22}{7} \times 14 \times 14 \times 72$

$\therefore \quad H = \dfrac{22 \times 72}{66} = 24$ cm.

**73.** **(c)** Volume of the iron rod $= \dfrac{22}{7} \times 1 \times 1 \times 70$

= 220 cu cm.

$\therefore$ Weight of the cylinder $= \dfrac{220 \times 10}{1000} = 2.2$ Kg.

**74.** **(a)** Let, the initial radius and height of the cylinder be $r$ cm and $h$ cm, respectively.

Then, curved surface area of the original cylinder = $2\pi rh$ and curved surface area of the new cylinder

$= 2\pi(2r) \times \dfrac{h}{2} = 2\pi rh$

$\therefore$ Required ratio

$= \dfrac{\text{New curved surface area}}{\text{Previous curved surface area}}$

$= \dfrac{2\pi rh}{2\pi rh} = 1{:}1.$

**75.** **(d)** Volume of the water in jar $= \pi \times 12^2 \times 30 \text{ cm}^3$

When the ball is dropped into the jar, volume of water + ball

$= \pi \times 12^2 \times (30 + 6.75)$

Increase in volume

$= \pi \times 12^2 \times (30 + 6.75 - 30) \text{ cm}^3$

$= \pi \times 144 \times 6.75 \text{ cm}^3$

It $r$ is the radius of the ball, then

$\dfrac{4}{3}\pi r^3 = \pi \times 144 \times 6.75$

$\Rightarrow \quad r^3 = \dfrac{144 \times 6.75 \times 3}{4} = 729$

$\Rightarrow \quad r^3 = 9^3$

$\therefore \quad r = 9$

Thus, diameter of ball = $2r$ = 18 cm.

**76.** **(b)** Volume of the cylinder = 3 times volume of the cone. This is valid if base and height is the same. Radius is the same, so the height of cone is 3 times the height of the cylinder.

$\therefore$ Height of the cone = 3 × 5 cm = 15 m.

**77.** **(b)** $\dfrac{\text{First volume of cylinder}}{\text{Second volume of cylinder}}$

$= \dfrac{(\text{First radius})^2}{(\text{Second radius})^2} \times \dfrac{\text{First height}}{\text{Second height}}$

or, $\dfrac{3850}{\text{Second volume}} = \left(\dfrac{2}{1}\right)^2 \times \dfrac{1}{2}$

$\therefore$ Second volume $= \dfrac{1}{2} \times 3850 = 1925 \text{ mm}^2$.

**78.** **(c)** Radius of each pillar = 25 cm $= \dfrac{1}{4}$ m

Curved surface of one pillar = $2\pi rh$

$= 2 \times 3.14 \times \dfrac{1}{4} \times 4 = 6.28 \text{ m}^2$

$\therefore$ Curved surface of the 50 pillars = 314 $\text{m}^2$

Required cost of cleaning these pillars

$= 314 \times \dfrac{50}{100} = ₹157.$

**79.** **(a)** Let, $r$ be the radius and $h$ be the height

$\pi(2r)^2 \times H = \pi r^2 h \quad \therefore \quad H = \dfrac{1}{4} \cdot h.$

**80.** **(b)** $\dfrac{4}{3}\pi r^3 = \dfrac{4}{3}\pi \times \left\{\left(\dfrac{3}{2}\right)^3 - \left[\left(\dfrac{3}{4}\right)^3 + 1^3\right]\right\}$

$\therefore \quad r^3 = \dfrac{125}{64}$

$\therefore \quad r^3 = \left(\dfrac{5}{4}\right)^3$

$\therefore \quad r = \dfrac{5}{4}$

$\therefore$ Diameter $= 2r = 2 \times \dfrac{5}{4} = \dfrac{5}{2} = 2.5$ cm.

**81.** **(d)** $\pi rl = 2\pi r \cdot b$, where $b$ = 2 m $\Rightarrow$ $l$ = 4 m.

**82.** **(b)** Let, the height and radius of the cylinder be $h$ and $r$, respectively.

Curved surface of the cylinder = $2\pi rh$

Curved surface of the cone = $\pi rl = \pi rh$ ($h = l$)

$\therefore$ Required ratio = 2:1.

**83.** **(a)** Cylinder of largest possible volume is of base with diameter 1 m and height 1 m.

$\therefore$ The volume of this cylinder $= \pi \times \left(\dfrac{1}{2}\right)^2 \times 1$

$= \dfrac{\pi}{4} \text{ cm}^3.$

Hence, the volume of the remaining word is equal to $1 - \dfrac{\pi}{4}$

$= 1 - \dfrac{22}{7 \times 4} = \dfrac{3}{4}.$

**84. (c)** Volume of cylinder = $\pi r^2 \times 3$ cm$^3$.

Volume of cone = $\frac{1}{3}\pi r^3 h$ m$^3$.

$\therefore\ \frac{1}{3}\pi r^2 h = 3\pi r^2$ or $h = 9$ cm.

**85. (c)** Volume of rain water
= Area × height = (1 Km)$^2$ × 2 cm
= (1000 m)$^2$ × 0.02 m = 20000 m$^3$
Volume of collected water = 50% of 20000 m$^3$

$= \frac{1}{2} \times 20000$

= 10000 m$^3$

$\therefore$ Increased level in pool

$= \frac{\text{Volume collected}}{\text{Base area of pool}} = \frac{10000}{10 \times 100} = 10$ m

$\therefore$ The water level would be increased by 10 m.

**86. (b)** $h = \frac{14}{3}$ m, $r = 3$ m

Volume = $\frac{22}{7 \times 3} \times 3 \times 3 \times \frac{14}{3} = 44$ cm$^3$

Average of air/person = $\frac{44}{11} = 4$ m$^3$.

**87. (a)** $2 \times \frac{22}{7} \times r = 44$ m

So, $r = 7$ m

Volume of the conical tent = $\frac{1}{3}\pi r^2 h$

$= \frac{1}{3} \times \frac{22}{7} \times 7^2 \times 9$

= 462 m$^3$.

**88. (c)** Volume of conical vessel

$= \frac{1}{3} \times \frac{22}{7} \times 2 \times 2 \times 3$

$= \frac{88}{7}$ cm$^3$.

If the level of kerosene in the jar is $x$ cm.

$\frac{88}{7} = \pi \times 2 \times 2 \times h = \frac{22}{7} \times 4 \times h$

$\therefore\ h = 1$ cm.

**89. (b)** Let, the radius of the solid cylinder be $r$ cm

$\therefore\ \pi r^2 \times 9 = \pi\,[(4.3)^2 - (1.1)^2] \times 3$

$\Rightarrow\ r^2 = \frac{3}{9}\ (4.3 + 1.1)\ (4.3 - 1.1)$

$= \frac{1}{3} \times 5.4 \times 3.2 = 5.76$

$r = \sqrt{5.76} = 2.4$ cm.

**90. (c)** Let, the height of the cylinder be $H$ and its radius = $r$.

Then, $\pi r^2 H + \frac{1}{3}\pi r^2 h = 3 \times \frac{1}{3}\pi r^2 h$

$\therefore\ \pi r^2 H = \frac{2}{3}\pi r^2 h$ or, $H = \frac{2}{3} h$.

**91. (b)** Volume of earth dug out

$\pi r^2 h = \frac{22}{7} \times \left(\frac{11.2}{2}\right)^2 \times 8$

$= \frac{22}{7} \times 5.6 \times 5.6 \times 8 = 788.48$ m$^3$.

Area of embankment
$= \pi\,(5.6 + 7)^2 - \pi\,(5.6)^2$
$= \pi\,[(5.6 + 7)^2 - (5.6)^2]$
$= \pi\,[(5.6 + 7 + 5.6)\ (5.6 + 7 - 5.6)]$

$= \frac{22}{7}\ [18.2 \times 7]$

= 400.4 m$^2$.

**92. (a)** Curved surface area of cylinder = $2\pi rh$.
Slant surface area of the cone
$= \pi rl = \pi \times r \times 2h = 2\pi rh$
$\therefore$ The ratio of the two surface areas
$= 2\pi rh : 2\pi rh = 1:1$.

**93. (b)** $\frac{1}{3}\pi r^2 \times h = \pi r^2 \times 5$, or, $h = 15$ cm.

**94. (a)** Edge of the cube = $\sqrt[3]{343} = 7$ cm.

$\therefore$ Radius of the cone = 3.5 cm and height = 7 cm.

$\therefore$ Volume of the cone

$= \frac{1}{3}\pi r^2 h$

$= \frac{1}{3} \times \frac{22}{7} \times 3.5 \times 3.5 \times 7$

$= \frac{1}{3} \times 22 \times 12.25$

= 90 c.c.

**95. (c)** Volume of the cone

$= \frac{1}{3}\pi r^2 h$

$= \frac{1}{3} \times \frac{22}{7} \times 50 \times 50 \times 25$ c.c.

Volume of the sphere = $\frac{4}{3}\pi R^3$

Since the sphere is made from the cone, their volumes will be equal

$\therefore\ \frac{4}{3}\pi R^3 = \frac{1}{3} \times \frac{22}{7} \times 50 \times 50 \times 25$

$\Rightarrow\ R^3 = \frac{1}{3} \times \frac{22}{7} \times 50 \times 50 \times 25 \times \frac{3}{4} \times \frac{7}{22}$

or, $R^3 = 353$

or, $R = 25$ cm

Surface area of the sphere

$= 4\pi R^2$

$= 4 \times \frac{22}{7} \times 25 \times 25 = \frac{55000}{7}$

$= 7857.14$ cm$^2$.

**96. (a)** $\frac{1}{3} \times \pi \times (5x)^2 \times 12x = 314\frac{3}{7}$

$\Rightarrow \quad \frac{1}{3} \times \frac{22}{7} \times 25 \times 12x^3 = \frac{2200}{7} \quad \Rightarrow \quad x^3 = 1$

i.e., $x = 1$.

$\therefore$ Radius $= 5x = 5 \times 1 = 5$ m.

**97. (b)** $\frac{1}{3}\pi \times r^2 \times r : \frac{2}{3}\pi r^3 : \pi r^2 \times r$

[height = radius of base]

or, 1:2:3.

**98. (c)** Curved surface of the tent $= \pi rl$

$= \frac{22}{7} \times 6 \times 6.3$ m$^2$

$= 118.8$ m$^2$

$\therefore$ Length of the canvas $= \frac{118.8}{2}$ m $= 59.4$ m.

**99. (c)** Let, the initial radius and height of the cylinder be $r$ cm and $h$ cm, respectively.

Then, $V_1 = \pi r^2 h$ and $V_2 = \pi\,(2r)^2 \frac{h}{2} = 2\pi r^2 h$.

$\frac{\text{New volume}}{\text{Previous volume}} = \frac{2\pi r^2 h}{\pi r^2 h} = \frac{2}{1} = 2:1.$

**100. (c)** Curved surface area of the cylindrical portion

$= 2\pi rh$

$= 2 \times \frac{22}{7} \times \frac{105}{2} \times 3$

$= 990$ m$^2$

Lateral surface area of the conical portion

$= \pi rl = \frac{22}{7} \times \frac{105}{2} \times 53$

$= 8745$ m$^2$

Total surface area $= 990 + 8745 = 9735$ m$^2$.

Width of the canvas = 5 m.

$\therefore$ Length of the canvas $= 9735 \div 5 = 1947$ m.

**101. (a)** Radius of the cone

$= r + 20\%$ of $r = 1.2\,r$ cm

and, slant height = 2l cm

$\therefore$ Surface area of the new cone

$= 2\pi \times 1.2\,r \times 2l$

$= 2\pi \times 2.4\,rl$ cm$^2$

Increase in surface area

$= 2\pi \times 2.4\,rl - 2\pi rl$

$= 2\pi \times 1.4\,rl$ cm$^2$

Percentage increase

$= \frac{2\pi \times 1.4\,rl}{2\pi\,rl} \times 100 = 140\%$

Therefore, surface area of the cone will be increased by 140%.

**102. (d)** Area of the canvas $= \pi rl = \pi \times 5 \times 13 = 65\,\pi$

$[l = \sqrt{5^2 + 12^2} = \sqrt{169} = 13]$

**103. (a)** Total volume $= (10 \times 5 \times 2)$ cm$^3$

$= 100$ cm$^3$

Volume carved $= \left(\frac{1}{3} \times \frac{22}{7} \times 3 \times 3 \times 7\right)$ cm$^3$

$= 66$ cm$^3$.

Wood wasted $= (100 - 66)\% = 34\%$

**104. (b)** Curved surface of the tomb

$= \pi rl = \frac{22}{7} \times 14 \times 50 = 22000$ m$^2$

$\therefore$ Cost of white washing

$= 22000 \times 0.80 =$ ₹1760.

**105. (a)** Length of the sheet $= \frac{264}{\pi} = 24$ cm

When the sheet is rolled along its breadth, the width of the sheet will be equal to the circumference of the cylinder and the length of the sheet will be height of the cylinder.

$\therefore$ Radius of the cylinder formed

$= \frac{11}{2\pi} = \frac{11}{2} \times \frac{22}{7} = \frac{7}{4}$ cm

Volume of the cylinder

$= \pi r^2 h = \frac{22}{7} \times \frac{7}{4} \times \frac{7}{4} \times 24 = 231$ cm$^3$.

**106. (c)** $h_1 : h_2 = 2:3$,

$r_1 : r_2 = 3:4$

Ratio of volumes $V_1 : V_2 = \pi\,(3)^2 \times 2 : \frac{1}{3}\pi \times 4^2 \times 3$

$= 9:8$.

**107. (a)** Original volume $= \frac{1}{3}\pi r^2 h$

New volume $= \frac{2}{3}\pi r^2 h$

Increase % $= \left(\frac{\frac{1}{3}\pi r^2 h}{\frac{1}{3}\pi r^2 h} \times 100\right)\% = 100\%$

**108. (b)** Volume of the cubes with sides 3, 4 and 5 cm are $3^3$, $4^3$ and $5^3$, respectively.

$\therefore$ Total volume $= 3^3 + 4^3 + 5^3$ cm$^3$

$= 27 + 64 + 125$

$= 216$ cm$^3$.

**109.** **(d)** Let, radius of the cone = $r$, height = $h$.

Then, volume of the cone = $\frac{1}{3}\pi r^2 h$.

Increased radius = $2r$, height = $2h$

$\therefore$ Increased volume

$= \frac{1}{3}\pi(2r)^2\,(2h) = \frac{1}{3}\pi \times 8r^2h = 8\left(\frac{1}{3}\pi r^2 h\right)$

= 8 times the original volume.

**110.** **(c)** Original volume = $\frac{4}{3}\pi r^3$

New volume $= \frac{4}{3}\pi\,(2r)^3 = \frac{32}{3}\pi r^3$

Increase % $= \left(\frac{28}{3}\pi r^3 \times \frac{3}{4\pi r^3} \times 100\right)\%$ = 700%

**111.** **(c)** Radius of the sphere = 3 cm

Volume of the sphere $= \frac{4}{3}\neq r^3$

$= \frac{4}{3} \times \pi \times 3 \times 3 \times 3$

$= 36\pi$ cm$^3$ ...(1)

Radius of the wire = 0.1 m.

Volume of the wire with its length l cm and radius 1.0 m

$= \pi r^2 l = \pi \times 0.1 \times 0.1 \times l$ ...(2)

Now, $36\pi = \pi \times 0.1 \times 0.1 \times l$

$\Rightarrow \quad l = \frac{36\pi}{\pi \times 0.1 \times 0.1}$ = 3600 cm = 36 m.

**112.** **(b)** If $r$ is the radius of the base, then the circumference of the base = $2\pi r$ = 44 m.

$\therefore \quad r = \frac{44 \times 7}{2 \times 22}$ = 7 cm

The height of the cone = $h$

Then, the volume of the air in the tent

$= \frac{1}{3}\pi r^2 h$

$= \frac{1}{3} \times \frac{22}{7} \times 7 \times 7 \times 9$

$= 462$ m$^3$.

**113.** **(c)** Original area = $2\pi r^2$.

New area = $4\pi\,(2r)^2 = 16\pi r^2$.

Increase % $= \left(\frac{12\pi r^2}{4\pi r^2} \times 100\right)\%$ = 300%

**114.** **(c)** Here, $x = y = 0$ and $z = -8$.

$\therefore$ Percentage change in volume

$= \left[x + y + z + \frac{xy + yz + zx}{100} + \frac{xyz}{(100)^2}\right]\%$

$= \left[0 + 0 - 8 + \frac{0 \times 0 + 0 \times .8 + 0 \times .8}{(100)^2}\right]\%$

= –8%

$\therefore$ Volume of the cylinder decreases by 8%.

**115.** **(b)** Here, $x = y = 20$ and $z = 0$.

$\therefore$ Percentage increase in volume

$= \left[x + y + z + \frac{xy + yz + zx}{100} + \frac{xyz}{(100)^2}\right]\%$

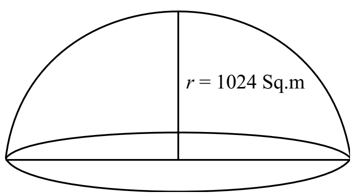
$= \left[20 + 20 + 0 + \frac{20 \times 20 + 20 \times 0 \times 20 \times 0}{100} + \frac{20 + 20 \times 0}{(100)^2}\right]\%$

= (40 + 4)% = 44%

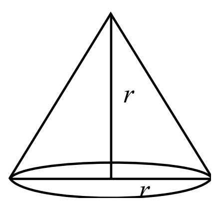
## Exercise-2
## (Based on Memory)

**1.** **(d)** Area of the square field

= Area of the rectangles field = 1024 m$^2$




Volume $= \frac{1}{2} \times \frac{4}{3}\pi r^3 = \frac{2}{3}\pi r^3$




Volume $= \frac{1}{3}\pi r^2 \cdot r = \frac{1}{3}\pi r^3$

$\therefore$ Required ratio = 2:1.

**2. (d)** Given:

$\pi r^2 h = 924$ ...(1)

$2\pi rh = 264$ ...(2)

Where $r$ = radius of the cylindrical pillar

$\therefore$ Eq. (1) ÷ Equation (2) gives

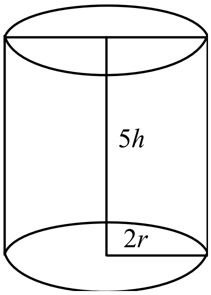
$$\frac{\pi r^2 h}{2\pi rh} = \frac{924}{264} \quad \Rightarrow \quad \frac{r}{2} = \frac{231}{66} = \frac{7}{2}$$

$\Rightarrow \quad r = 7 \Rightarrow \text{Diameter} = 14$.

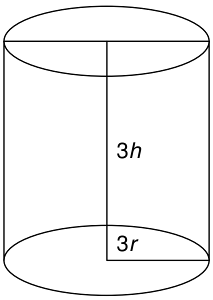
(2) $\Rightarrow 2\pi \times 7 \times h = 264$
$\Rightarrow 44h = 264 \Rightarrow h = 6$

$\therefore$ Required ratio: $\frac{2r}{h} = \frac{14}{6} = \frac{7}{3}$.

**3. (b)**




Volume $= \pi \times (2r)^2 \times 5h$
$= 20\pi r^2 h$




Volume $= \pi \times (3r)^2 \times 3h$
$= 27\pi r^2 h$

$\therefore$ Required ratio = 20:27.

**4. (b)** Let, $l$, $b$ and $h$ be the length, brea cdth and height of the cuboidal tank, respectively.

$\therefore \quad h = \frac{1}{3}l, b = \frac{1}{2} \text{ of } \frac{1}{3} \text{ of } (l - h)$

$= \frac{1}{6}l - \frac{1}{6}h = \frac{1}{6}l - \frac{1}{18}l = \frac{l}{9}$

$\therefore \quad l \times b \times h = 216$ [Given]

$\Rightarrow \quad l \times \frac{l}{9} \times \frac{l}{3} = 216 \Rightarrow l = 18$

**5. (b)** Let, $r$ be the radius of the sphere.

$\therefore \quad \pi \times (8)^2 \times 2 = 12 \frac{4}{3} \times \pi \times r^3$

$\Rightarrow \quad r^3 = \frac{128 \times 3}{48} = 8 \Rightarrow r = 2a$

$\Rightarrow$ Diameter of the shpere = 4 cm.

**6. (b)** Area of the curved surface = $2\pi rh$ = 88.

$\therefore \quad h$ = 8. Therefore, $2\pi r$ = 11

$\Rightarrow \quad r = \frac{7}{4}$

$\therefore$ Volume = $\pi r^2 h$ = $\frac{22}{7} \times \frac{49}{16} \times 8$ = 77 cm$^3$.

**8. (c)** Required number of cubes

$= \left(\frac{15}{3}\right)^3$ = 5 × 5 × 5 = 125.

**9. (c)** $\left(\sqrt[3]{\frac{27}{64}}\right)^2 = \frac{9}{16}$.

**10. (b)** $\frac{2 \times 2 \times 5}{3 \times 3 \times 3}$ = 20:27.

**11. (b)** Here, $\pi r^2$ = 1.54 Km$^2$.

$\therefore \quad r$ = 0.7 Km, $l$ = 2.5 Km (given)

Therefore, $h = \sqrt{l^2 - r^2}$

$= \sqrt{(2.5)^2 - (0.7)^2}$

= 2.4 Km.

**12. (b)** $\frac{2\pi r^2}{\pi r\sqrt{r^2 + r^2}} = \frac{2}{\sqrt{2}} = \frac{\sqrt{2}}{1}$.

**13. (d)** $\sqrt[3]{6^3 + 8^3 + 10^3}$
= 12 cm.

**14. (c)** Here, radius ($r$) of the cone = $\frac{19.2}{2}$ = 9.6 m.

Slant height ($l$) of the cone = $\sqrt{(9.6)^2 + (2.8)^2}$ = 10 m.

Hence, area of the canvas required

= $\pi rl$ = $\frac{22}{7} \times 9.6 \times 10$ = 301.7 m$^2$.

**15. (a)** Volume of cuboidal block

= 10 × 5 × 2 = 100 cm$^3$

Volume of cone carved from the cuboidal block

$= \frac{1}{3} \times \frac{22}{7} \times 1 \times 1 \times 7 = \frac{22}{7}$ cm$^3$

Wood wasted = 100 − $\frac{22}{7} = \frac{278}{3} = 92\frac{2}{3}$ cm$^3$

Hence, required % = $92\frac{2}{3}$ %

**16.** **(d)** Total volume of three solid metallic balls
$= 3 \times 3 \times 3 + 4 \times 4 \times 4 + 5 \times 5 \times 5$
$= 27 + 64 + 125$
$= 216$ = volume of single solid ball.
Hence, required radius = $\sqrt[3]{216}$ = 6 cm.

**17.** **(b)** Volume of the cuboid
$= 9 \times 8 \times 6 \text{ cm}^3 = 432 \text{ cm}^3$
Volume of the cube = 216 $\text{cm}^3$
Side of the cube = 6 cm
The total surface area of the cube
$= 6 \times \text{side}^2 = 6 \times 6^2 = 216 \text{ cm}^2$.

**18.** **(d)** Curved surface of a pillar = 264 $\text{m}^2$
or, $2\pi rh = 264 \text{ m}^2$
or, $rh = \dfrac{264 \times 7}{2 \times 22}$
$\therefore \quad rh = 42 \text{ m}^2$ ...(1)
Again, $\pi r^2 h = 924 \text{ m}^3$
$r^2 h = \dfrac{924}{22} \times 7$
$\therefore \quad r^2 h = 294$ ...(2)
Dividing Equation (2) by Equation (1)
$r = 7\ m$
$\therefore \quad h = \dfrac{42}{7} = 6$ m
Hence, required ratio = $7 \times 2 : 6 = 7 : 3$.

**19.** **(d)** $\sqrt{6^2 + 5^2 + 4^2} = \sqrt{77}$

**20.** **(a)** $\dfrac{\pi \times (3)^2 \times 8}{\pi (0.75)^2 \times 0.2} = 640.$

**21.** **(a)** $\pi r^2 = 154 \quad \Rightarrow \quad r^2 = \dfrac{154 \times 7}{77} \quad \Rightarrow \quad r = 7$
$\therefore$ The curved surface of the cone
$= \pi rl = \dfrac{22}{7} \times 7 \times \sqrt{7^2 + 14^2}$
$= 22 \times \sqrt{245} = 154\sqrt{5} \text{ cm}^2$.

**22.** **(b)** Let, $l \times b = 120$, $l \times h = 72$ and $b \times h = 60$.
$\therefore \quad \dfrac{b}{h} = \dfrac{120}{72} = \dfrac{5}{3} \Rightarrow h = 6$
$\therefore \quad l = 12, b = 10, h = 6$
$\therefore$ Volume of the box = 720 $\text{cm}^3$.

**23.** **(c)** Volume of circular cone = $\dfrac{1}{3}\pi r^2 h$
or, $\dfrac{1}{3} \times \dfrac{22}{7} \times 24 \times r^2 = 1232$
or, $r^2 = \dfrac{1232 \times 3 \times 7}{22 \times 24} = 22 \times 25 = 550 \text{ cm}^2$.

**24.** **(d)** Required ratio = $\dfrac{4\pi \times 40 \times 40}{4\pi \times 10 \times 10} = 16:1$.

**25.** **(c)** Volume of the metal
$= \dfrac{22}{7} \times 21 \left[ \left( \dfrac{11.2 + 2 \times 0.4}{2} \right)^2 - \left( \dfrac{11.2}{2} \right)^2 \right]$
$= 66\,[6^2 - 5.6^2] = 66 \times 11.6 \times 0.4$
$= 306.24 \text{ cm}^3$.

**26.** **(a)** Volume of the wood
$= [20 \times 12 \times 10] - [(20 - 2)(12 - 2)(10 - 2)]$
$= 2400 - 1400 = 960 \text{ cm}^3$.

**27.** **(c)** Volume of iron = $\dfrac{22}{7} \times 20(4^2 - 3^2)$
$= \dfrac{22}{7} \times 20 \times 7 = 440 \text{ cm}^3$.

**28.** **(c)** Volume of the box = $\sqrt{120 \times 72 \times 60} = 720 \text{ cm}^3$

**29.** **(a)** Water flowed by the pipe in 1 hr = $\pi r^2 h$
$= \dfrac{22}{7} \times \dfrac{7 \times 7}{100 \times 100} = 5000 \text{ m}^3$
$= 77 \text{ m}^3$
Volume of expected water in the tank
$= \dfrac{50 \times 4 \times 7}{100} = 154 \text{ m}^3$
Hence, required time taken for the rise in the level of water in the tank = $\dfrac{154}{77}$ = 2 hours

**30.** **(d)** Let, the length, breadth and height of the cuboid be $x$, $y$ and $z$ cm, respectively, then
$xy = 12;\ yz = 20;\ zx = 15$
Therefore, $x^2 y^2 z^2 = 12 \times 12 \times 15 = 3600 \text{ cm}^6$
Hence, $v = xyz = \sqrt{3600}$
$v = 60 \text{ cm}^3$

**31.** **(b)** Water flowed through the pipe in 1 hours
$= \dfrac{22}{7} \times \dfrac{10 \times 10 \times 3000}{10000}$
$= \dfrac{660}{7} \text{ m}^3$
Volume of cylinder/cylindrical cistern
$= \dfrac{22}{7} \times 5 \times 5 \times 2$
$= \dfrac{1100}{7} \text{ m}^3$
Hence, required time
$= \dfrac{\frac{1100}{7}}{\frac{660}{7}} = \dfrac{5}{3}$ hours
= 1 hour 40 minute

**32.** **(b)** Volume of raised water in the cylindrical leaker
$\pi r^2 h = \dfrac{22}{7} \times \dfrac{7}{2} \times \dfrac{7}{2} \times 5.6$
$= 215.6 \text{ cm}^3$

Volume of marble = $\frac{4}{3}\pi r^3$

$= \frac{4}{3}\times\frac{22}{7}\times(0.7)^3 = \frac{4.312}{3}$ cm$^3$

Hence, number of marbles

$= \frac{215.6}{\frac{4.312}{3}} = \frac{215.6\times 3}{4.312} = 150$

**33.** **(b)** Let, the radius of base of the hemisphere be $r$ units. Then, radius of the base of cone = $r$ units and height = $r$ units.

Therefore, slant height ($l$)

$= \sqrt{r^2+r^2} = \sqrt{2r^2} = \sqrt{2}r$

Hence, the curved surface area of the hemisphere: The curved surface area of the cone

$= 2\pi r^2 : \pi r \times \sqrt{2}r = 2 : \sqrt{2}$

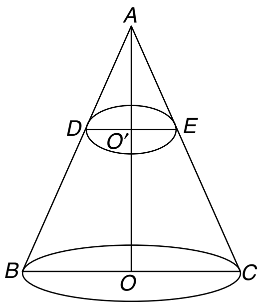
**34.** **(d)** Let, the side of cube is $x$, then volume of the cube $= x^3$

One side of the cube after increasing = $2x$.

∴ Required % increase of volume

$= \frac{x\times x\times 2x - x^3}{x^3}\times 100 = 100\%$

**35.** **(b)** Let, $H$ and $R$ be the height and radius of bigger cone and $h$ and $r$ be the height and radius of smaller cone.




From triangles $AOB$ and $AMN$.

$\angle A$ is common and $MN \parallel OB$.

∴ Triangles $AOB$ and $AMN$ are similar,

$\therefore \frac{AO}{AM} = \frac{BO}{MN}$

$\Rightarrow \frac{30}{h} = \frac{R}{r}$ ...(1)

Volume of smaller cone $= \frac{1}{3}\pi r^2 h$

Volume of bigger cone $= \frac{1}{3}\pi R^2 H$

∴ Now, according to the question,

$\Rightarrow \frac{1}{3}\pi r^2 h = \left(\frac{1}{3}\pi R^2 H\right)\times\frac{1}{27}$

$\Rightarrow r^2 h = \frac{R^2 H}{27}$

$\Rightarrow 27r^2 h = R^2 H$

$\Rightarrow \frac{27h}{H} = \frac{R^2}{r^2}$

$\Rightarrow \frac{27h}{H} = \left(\frac{30}{h}\right)^2$ [From (1)]

$\Rightarrow \frac{27h}{H} = \frac{900}{h^2}$

$\Rightarrow 27h^3 = 900H = 900\times 30$

$\Rightarrow h^3 = \frac{900\times 30}{27} = 1000$

$\Rightarrow h = \sqrt[3]{1000} = 10$ cm

∴ Required height = (30 − 10) = 20 cm

**36.** **(c)** Surface area of sphere = $4\pi r^2$

Now, according to the question,

$4\times\frac{22}{7}\times r^2 = 346.5$

$\Rightarrow 4\times 22\times r^2 = 346.5\times 7$

$\Rightarrow r^2 = \frac{346.5\times 7}{4\times 22} = 27.5625$

$\Rightarrow r = \sqrt{27.5625} = 5.25$ cm

**37.** **(a)** Volume of pyramid $= \frac{1}{3}\times$ Area of base $\times$ Height

$\Rightarrow 500 = \frac{1}{3}\times 30\times h$

$\Rightarrow 10h = 500$

$\Rightarrow h = \frac{500}{10} = 50$ m

**38.** **(c)** Hypotenuse of base $= \sqrt{5^2+12^2}$

$= \sqrt{25+144} = \sqrt{169} = 13$ cm

∴ Surface area = $h(a + b + c)$

= 10 (5 + 2 + 13) = 300 cm$^2$

Area of base $= \left(\frac{1}{2}\times 5\times 12\right) = 30$ cm$^2$

∴ Total surface area of lateral surfaces = (300 + 30) = 330 cm$^2$

**39.** **(a)** Lateral surface area of prism = 3 × side × height

∴ 3 × side × height = 120

$\Rightarrow$ Side × height $= \frac{120}{3} = 40$ cm$^2$ ...(1)

Volume of prism = Area of base × height

$\Rightarrow 40\sqrt{3} = \frac{\sqrt{3}}{4}\times \text{side}^2\times\text{height}$

$\Rightarrow \frac{40\sqrt{3}\times 4}{\sqrt{3}} = \text{side}^2\times\text{height}$

∴ side$^2$ × height = 160 cm$^3$ ...(2)

Dividing equation (2) by (1), we get

$$\text{Side} = \frac{160}{40} = 4 \text{ cm}$$

**40.** **(d)** Volume of lead $= \frac{4}{3}\pi r^3 = \frac{4}{3}\pi \times 2^3$

Let, the thickness of gold be $x$ cm.

$\therefore$ Volume of gold $= \frac{4}{3}\pi((2+x)^3 - 2^3)$ cm$^3$

Now, according to the question,

$$\frac{4}{3}\pi((2+x)^3 - 2^3) = \frac{4}{3}\pi \times 2^3$$

$\Rightarrow (2+x)^3 - 2^3 = 2^3$

$\Rightarrow (2+x)^3 = 8 + 8 = 16$

$\Rightarrow (2+x)^3 = 2^3 \times 2$

$\Rightarrow 2 + x = 2 \times \sqrt[3]{2}$

$\Rightarrow 2 + x = 2 \times 1.259 = 2.518$

$\therefore x = 2.518 - 2 = 0.518$ cm

**41.** **(d)** Let, the radius of larger sphere be $R$ units

$\therefore$ Its volume $= \frac{4}{3}\pi R^3$ cu units

Volume of smaller cone $= \frac{1}{3}\pi R^3$ cubic units

Volume of smaller sphere $= \frac{4}{3}\pi r^3$

[Where, $r$ = radius of smaller sphere]

Now, according to the question,

$$\frac{4}{3}\pi r^3 = \frac{1}{3}\pi R^3$$

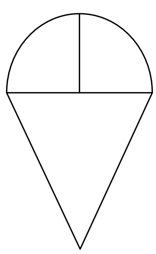
$\Rightarrow r^3 = \frac{R^3}{4} \Rightarrow r = \frac{R}{\sqrt[3]{4}}$

$\therefore$ Surface area of smaller sphere:Surface area of larger sphere $= 4\pi r^2 : 4\pi R^2 = r^2 : R^2$

$$= \left(\frac{R}{\sqrt[3]{4}}\right)^2 : R^2 = 1 : \left(\sqrt[3]{4}\right)^2$$

$$= 1 : \left((2^2)^{\frac{1}{3}}\right)^2 = 1 : 2^{\frac{4}{3}}$$

**42.** **(a)**



Volume of hemisphere $= \frac{2}{3}\pi r^3$,

where $r$ = radius = 7 cm

$$= \left(\frac{2}{3} \times \frac{22}{7} \times 7 \times 7 \times 7\right) \text{ cm}^3$$

Volume of conical part $= \frac{1}{3}\pi r^2 h \quad [\because r = h]$

$$= \left(\frac{1}{3} \times \frac{22}{7} \times 7 \times 7 \times 7\right) \text{ cm}^3$$

$\therefore$ Volume of ice cream

$$= \frac{2}{3} \times \frac{22}{7} \times 7^3 + \frac{1}{3} \times \frac{22}{7} \times 7^3$$

$$= \frac{22}{7} \times 7^3 = 22 \times 7^2 = 1078 \text{ cm}^3$$

**43.** **(c)** Quicker Method:

Single equivalent increase for 10% and 10%

$$= \left(10 + 10 + \frac{10 \times 10}{100}\right)\% = 21\%$$

Again, single equivalent increase for 21% and 10%

$$= \left(21 + 10 + \frac{21 \times 10}{100}\right)\%$$

$$= 31 + 2.1 = 33.1\%$$

**44.** **(c)** Volume of the cone $= \frac{1}{3}\pi r^2 h = \frac{\pi}{3} \times 1.6 \times 1.6 \times 3.6$

$$= \pi \times 1.6 \times 1.6 \times 1.2 \text{ cm}^3$$

Now, according to the question,

$$\frac{1}{3}\pi \times 1.2 \times 1.2 \times H = \pi \times 1.6 \times 1.6 \times 1.2$$

$$\therefore H = \frac{1.6 \times 1.6 \times 3}{1.2} = 6.4 \text{ cm}$$

**45.** **(d)** Radius of the base of cone = $r$ units

$\therefore$ Volume $(v) = \frac{1}{3}\pi r^2 h$

Curved surface area $= \pi r\sqrt{h^2 + r^2}$

$$\therefore 3\pi v h^3 - c^2 h^2 + 9v^2 = 3\pi \times \frac{1}{3}\pi r^2 h \times h^3$$

$$-\pi^2 r^2 (h^2 + r^2) h^2 + 9 \times \frac{1}{9}\pi^2 r^4 h^3$$

$$= \pi^2 r^2 h^4 - \pi^2 r^2 h^4 - \pi^2 r^4 h^2 + \pi^2 r^4 h^2 = 0$$

**46.** **(d)** $\pi r^2 = 154$

$\Rightarrow \frac{22}{7} \times r^2 = 154$

$\Rightarrow r^2 = \frac{154 \times 7}{22} \Rightarrow r = 7$ m

$\therefore \frac{1}{2}\pi r^2 h = 1232$

$\Rightarrow \frac{h}{3} = \frac{1232}{154} = 8 \Leftrightarrow h = 24$ m

Area of canvas $= \pi r l = \pi r\sqrt{h^2 + r^2}$

$$= \frac{22}{7} \times 7 \times \sqrt{24^2 + 7^2} \text{ m}^2$$

$$= 22 \times 25 = 550 \text{ m}^2$$

$$\Rightarrow \text{ Its length} = \left(\frac{550}{2}\right) = 275 \text{ metres}$$

**47. (d)** Let, the height of glass be $h$ cm.

$\therefore$ Radius $= \frac{h}{2}$ cm

Volume of glass = volume of 32000 drops

$$\therefore \frac{1}{3}\pi\left(\frac{h}{2}\right)^2 \times h = \frac{4}{3}\pi\left(\frac{1}{20}\right)^3 \times 32000$$

$$\Rightarrow \frac{h^3}{4} = 4 \times \frac{1}{8000} \times 32000 \Leftrightarrow h^3 = 4^3 \Rightarrow h = 4 \text{ cm}$$

**48. (a)** Volume of the rectangular block = 11 × 10 × 5 = 550 cu m = 550000 cu dm

Volume of a sphere $= \frac{4}{3}\pi \times \frac{5}{2} \times \frac{5}{2} \times \frac{5}{2}$ cu dm $= \frac{500}{8}$ cu dm

$\therefore$ Required answer $= \frac{550000 \times 8}{500} = 8800$

**49. (a)** Volume of the block = 21 × 77 × 24 $\text{cm}^3$

Let, the radius of sphere be $r$ cm.

Now, according to the question,

$$\frac{4}{3}\pi r^3 = 21 \times 77 \times 24$$

$$\Rightarrow r^3 = \frac{21 \times 77 \times 24 \times 3 \times 7}{4 \times 22}$$

$$= 21 \times 7 \times 3 \times 3 \times 7 = 3^3 \times 7^3$$

$$\therefore r = 3 \times 7 = 21 \text{ cm}$$

**50. (a)** Let, the radius of cone be $r$ cm.

Now, according to the question,

$$\frac{1}{3} \times \frac{22}{7} \times r^2 \times 24 = 1232$$

$$\therefore r^2 = \frac{1232 \times 3 \times 7}{22 \times 24} = 49$$

$$\therefore r = \sqrt{49} = 7 \text{ cm}$$

$\therefore$ Area of the curved surface $= \pi r l = \pi r\sqrt{h^2 + r^2}$

$$= \frac{22}{7} \times 7\sqrt{24^2 + 7^2} = 22 \times 25 = 550 \text{ cm}^2$$

**51. (a)** Quicker Method:

Required percentage increase

$$= \left(50 + 50 + \frac{50 \times 50}{100}\right)\% = 125\%$$

**52. (c)** $\frac{4\pi r_1^2}{4\pi r_2^2} = \frac{4}{9} \Rightarrow \frac{r_1}{r_2} = \frac{2}{3}$

$$\therefore \frac{\frac{4}{3}\pi r_1^3}{\frac{4}{3}\pi r_2^3} = \left(\frac{2}{3}\right)^3 = \frac{8}{27}$$

**53. (d)** Quicker Method:

Percentage increase $= \left(50 + 50 + \frac{50 \times 50}{100}\right)\%$

= 125%

**54. (d)** Volume of the sphere $= \frac{4}{3}\pi r^3 = \frac{4}{3} \times \pi \times 9 \times 9 \times 9$

= 972$\pi$ cu cm

Let, the radius of the wire be $R$ cm.

Now, according to the question, $\pi R^2 \times 10800 = 972p$

$$\Rightarrow R^2 = \frac{972}{10800} = 0.09$$

$$\therefore R = \sqrt{0.09} = 0.3 \text{ cm}$$

$\therefore$ Diameter = 2 × 0.3 = 0.6 cm

**55. (b)** If the radius of the base of cup be $r$ cm, then $2\pi r = \pi \times 14$

$\Rightarrow r = 7$ cm

Slant height = 14 cm

$$\therefore \text{Height} = \sqrt{14^2 - 7^2} = \sqrt{21 \times 7} = 7\sqrt{3} \text{ cm}$$

$$\therefore \text{Capacity of cup} = \frac{1}{3}\pi r^2 h$$

$$= \frac{1}{3} \times \frac{22}{7} \times 7 \times 7 \times 7\sqrt{3} = 622.36 \text{ cm}^3.$$

**56. (a)** $S = 4\pi r^2$ and $V = \frac{4}{3}\pi r^3$

$$\therefore \frac{S^3}{V^2} = \frac{64\pi^3 r^6}{\frac{16}{9}\pi^2 r^6} = \frac{64\pi \times 9}{16} = 36\pi$$

**57. (d)** Volume of the sphere $= \frac{4}{3}\pi r^3 = \frac{4}{3}\pi \text{ cm}^3$

Volume of the wire = $\pi r^2 h = 100\pi r^2 \text{ cm}^3$

Now, according to the question

$$100\pi r^2 = \frac{4}{3}\pi$$

$$\Rightarrow r^2 = \frac{4}{300} = \frac{1}{75}$$

$$\therefore r = \sqrt{\frac{1}{75}} = 0.11 \text{ cm}$$

**58. (c)** Volume of the earth taken out

= (7.5 × 6 × 0.8) $\text{cm}^3$

= 36 $\text{cm}^3$

Area of the remaining field

= (18 × 15 – 7.5 × 6) $\text{m}^2$

= (270 – 45) $\text{m}^2$

= 225 $\text{m}^2$

$\therefore$ Level of the field raised $= \frac{36}{225}$ metres

$$= \frac{3600}{225} \text{ cm} = 16 \text{ cm}$$

**59.** **(c)** Area of the base $=\left(\frac{\sqrt{3}}{4}\times 4^2\right)=4\sqrt{3}\text{ cm}^2$

Median of the base $=\left(\sqrt{4^2-2^2}\right)=2\sqrt{3}\text{ cm}^2$

Distance of centroid from the side $=\frac{2\sqrt{3}}{3}$ cm

Let, the height of the pyramid be $h$ cm.

Now, according to the question,

$\therefore\ \sqrt{(2h)^2-h^2}=\frac{2\sqrt{3}}{3}$

$\Rightarrow\ \sqrt{3}h=\frac{2\sqrt{3}}{3}$

$\Rightarrow\ h=\frac{2}{3}$ cm

$\therefore$ Volume $=\frac{1}{3}\times\text{Area of base}\times\text{height}$

$=\frac{4\sqrt{3}\times 2}{3\times 3}=\frac{8\sqrt{3}}{9}\text{ cm}^3$

**60.** **(a)** 15 Km/h = 15000 m/hour

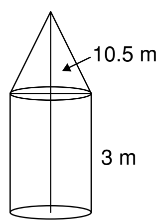
Water flown in an hour $=\frac{2\times 1.5\times 15000}{100}$

= 450 m$^3$

Volume of desired water in the tank = (150 × 100 × 3) m$^3$

$\therefore$ Time $=\frac{150\times 100\times 3}{450}=100$ hours

**61.** **(c)**




Slant height of cone $(l)=\sqrt{(10.5)^2+14^2}$.

$=\sqrt{110.25+196}=\sqrt{306.25}=17.5$ m

Curved surface area of the cone

$=\pi rl=\frac{22}{7}\times 14\times 17.5=770\text{ m}^2$

Curved surface area of cylinder = $2\pi rh$

$=2\times\frac{22}{7}\times 14\times 3=264\text{ m}^2$

$\therefore$ Total area = 264 + 770 = 1034 m$^2$

$\therefore$ Total cost = 2 × 1034 = ₹2068

**62.** **(c)** Quicker Method:

Percentage decrease $=\left(2x-\frac{x^2}{100}\right)^2\%$

$=(50-6.25)\%=43.75\%$

**63.** **(a)** Let, the radius be increased by $x$ cm.

$\therefore$ Volume of cylinder = $\pi(10+x)^2\times 4$

Again, let the height be increased by $x$ cm.

$\therefore$ Volume of cylinder = $\pi\times 10^2\ (4+x)$

Now, according to the question,

$\pi(10+x)^2\times 4=\pi(10)^2\ (4+x)$

$\Rightarrow\ (10+x)^2=25\ (4+x)$

$\Rightarrow\ 100+20x+x^2=100+25x$

$\Rightarrow\ x^2-5x=0$

$\Rightarrow\ x(x-5)=0$

$\Rightarrow\ x=5$ cm

**64.** **(c)** Let, the radius and height of the cone be $r$ CM and $h$ cm respectively.

Now, according to the question,

Required volume of water

$=\pi r^2h-\frac{1}{3}\pi r^2h=\frac{2}{3}\pi r^2h$

$=2\times\left(\frac{1}{3}\pi r^2h\right)$

= 2 × volume of cone

= (2 × 27$\pi$) = 54$\pi$ cm$^3$

Quicker Method:

Volume of required water = 2 × volume of cone

= 2 × 27$\pi$ = 54$\pi$ cm$^3$

**65.** **(b)** Volume of rain water = Area of base × height

$=1000000\times\frac{2}{100}=20000\text{ cm}^3$

Water stored in pool

= (50% of 20000) = 10000 cm$^3$

$\therefore$ Required water level $=\left(\frac{10000}{1000}\right)=10$ m

**66.** **(c)** Let, the radius of the base be $r$ = 3.5.

Now, volume of the water in the cylindrical can

$=\pi r^2\times 2r-\frac{4}{3}\pi r^3$

$=2\pi r^3-\frac{4}{3}\pi r^3$

[Here, $2r$ = height of the cylindrical can]

$=\frac{2}{3}\pi r^3$

Again, let the height of water in the cylindrical can be $h$ cm.

Therefore, according to the question,

$\pi r^2h=\frac{2}{3}\pi r^3$

$\Rightarrow\ h=\frac{\frac{2}{3}\pi r^3}{\pi r^2}=\frac{2}{3}r=\frac{2\times 3.5}{3}=\frac{7}{3}$ cm

Quicker Method: Increase in water level

$$= \frac{\text{Volume of sphere}}{\text{Area of base of cylinder}} = \frac{\frac{4}{3}\pi r^3}{\pi r^2}$$

$$= \left(\frac{4}{3}r = \frac{4}{3}\times 3.5\right) = \frac{14}{3} \text{ cm}$$

$\therefore$ Required water level $= \left(7 - \frac{14}{3}\right) = \frac{7}{3}$ cm

**67.** **(a)** Curved surface of cylinder = $2\pi rh$

Case II:

Radius $= \frac{1}{3}r$ and height = $6h$

Curved surface $= 2\pi \times \frac{1}{3}r \times 6h = (2\pi rh)\times 2$

$\therefore$ Increase in curved surface of cylinder will be twice.

**68.** **(b)** Let, the radius of the given cone be $r$ cm

Then, $\frac{1}{3}\pi r^2 h = 1232$

$\Rightarrow \frac{1}{3}\times\frac{22}{7}\times r^2\times 24 = 1232$

$\Rightarrow r^2 = \frac{1232\times 3\times 7}{22\times 24} = 49$

$\therefore r = \sqrt{49} = 7$ cm

$\therefore$ Slant height$(l) = \sqrt{h^2 + r^2}$

$= \sqrt{24^2 + 7^2} = \sqrt{625} = 25$ cm

$\therefore$ Curved surface of cone = $\pi rl$

$= \left(\frac{22}{7}\times 7\times 25\right) = 550 \text{ cm}^2$

**69.** **(c)** Total surface area of prism = Curved surface area + 2 × Area of base

$\Rightarrow$ 608 = Perimeter of base× height + 2 × Area of base

$\Rightarrow$ $608 = 4x \times 15 + 2x^2$

(Where $x$ = side of square)

$\Rightarrow$ $x^2 + 30x - 304 = 0$

$\Rightarrow$ $x^2 + 38x - 8x - 304 = 0$

$\Rightarrow$ $x(x + 38) - 8(x + 38) = 0$

$\Rightarrow$ $(x - 8)(x + 38) = 0$

$\Rightarrow$ $x = 8$

Volume of prism = Area of base × height

$= 8 \times 8 \times 15 = 960 \text{ cm}^3$

**70.** **(a)** $\frac{2}{3}\pi r^2 = 19404$

$\Rightarrow \frac{2}{3}\times\frac{22}{7}\times r^3 = 19404$

$\Rightarrow r^3 = \frac{19404\times 3\times 7}{2\times 22} = 9261$

$\therefore r = \sqrt[3]{21\times 21\times 21} = 21$ cm.

$\therefore$ Total surface area = $\pi r^2$

$= 3\times\frac{22}{7}\times 21\times 21$

$= 4158 \text{ cm}^2$

**71.** **(c)** Height of cone = height of cylinder = radius of hemisphere = $r$ units

$\therefore$ Ratio of the volumes of cone, cylinder and hemisphere

$= \frac{1}{3}\pi r_1^2 h : \pi r_2^2 h : \frac{2}{3}\pi r^3$

$= \frac{1}{3}\pi 2^2 r^3 : \pi 3^2 r^3 : \frac{2}{3}\pi r^3$

$= \frac{4}{3} : 9 : \frac{2}{3} = 4:27:2$

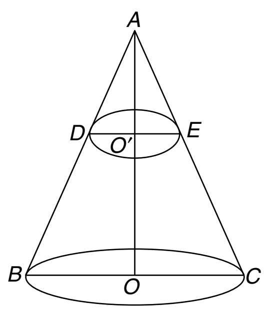
**72.** **(c)** Area of the base $= \frac{1}{2}\times(\text{diagonal})^2$

$= \frac{1}{2}\times 24\sqrt{2}\times 24\sqrt{2} = 576 \text{ m}^2$

$\therefore$ Volume of pyramid $= \frac{1}{3}\times$ height $\times$ area of base

$= 1728 = \frac{1}{3}\times h\times 576 \Rightarrow h = \frac{1728\times 3}{576} = 9$ m

**73.** **(b)**




Let, $DO' = r$ cm and $OO' = h$ cm

From similar triangle $ADO'$ and $ABO$ $\frac{AO}{AO} = \frac{DO}{BO}$

$\Rightarrow \frac{9-h}{9} = \frac{r}{3}$

$\Rightarrow 9 - h = 3r$

$\Rightarrow h = 9 - 3r$

Volume of frustum $= \frac{1}{3}\pi h(r_1^2 + r_2^2 + r_1 r_2)$

$\Rightarrow 44\frac{1}{3}\times\frac{22}{7}(9-3r)(9+r^2+3r)$

$\Rightarrow 44 = \frac{22}{7}(3-r)(3^2+3r+r^2)$

$\Rightarrow \frac{44\times 7}{22} = 3^3 - r^3 = 14 = 27 - r^3$

$\Rightarrow r^3 = 27 - 14 = 13$

$\therefore r = \sqrt[3]{13}$ cm

**74.** **(a)**

| First cylinder | Second cylinder |
|---|---|
| $r_1 = 2r$ | $r_2 = 3r$ |
| $h_1 = 5h$ | $h_2 = 4h$ |

$\therefore$ Required ratio $= 2\pi r_1 h_1 : 2\pi r_2 h_2$

$= 2\times5 : 3\times4 = 5:6$

**75.** **(c)** Let, the height of cylinder be $h$ cm and radius of base be $r$ cm.

Now, according to the question,

$$2\pi r^2 + 2\pi rh = 462 \qquad \ldots(1)$$

Area of curved surfaces = $2\pi rh$

$= \frac{1}{3}\times 462 = 154$

$\therefore \quad 2\pi r^2 + 154 = 462$

$\Rightarrow \quad 2\pi r^2 = 462 - 154 = 308$

$\Rightarrow \quad 2\times\frac{22}{7}\times r^2 = 308$

$\Rightarrow \quad r^2 = \frac{308\times7}{2\times22} = 49$

$\Rightarrow \quad r = 7$ cm

$\therefore \quad 2\pi rh = 154$

$\Rightarrow \quad 2\times\frac{22}{7}\times7\times h = 154$

$\Rightarrow \quad h = \frac{154}{2\times22} = \frac{7}{2}$ cm

$\therefore \quad$ Volume of cylinder $= \pi r^2 h$

$= \frac{22}{7}\times7\times7\times\frac{7}{2} = 539$ cm$^3$

**76.** **(d)** Let, the radius and the height be $r$ and $h$ respectively.

$$\frac{\text{Curved surface of cylinder}}{\text{curved surface of cone}} = \frac{8}{5}$$

$\Rightarrow \quad \frac{2\pi rh}{\pi r\sqrt{h^2+r^2}} = \frac{8}{5}$

$\Rightarrow \quad \frac{h}{\sqrt{h^2+r^2}} = \frac{4}{5}$

On squaring both sides, we have

$\frac{h^2}{h^2+r^2} = \frac{16}{25}$

$\Rightarrow \quad \frac{h^2+r^2}{h^2} = \frac{25}{16} \quad \Rightarrow \quad 1+\frac{r^2}{h^2} = \frac{25}{16}$

$\Rightarrow \quad \frac{r^2}{h^2} = \frac{25}{16} - 1 = \frac{9}{16} \quad \Rightarrow \quad \frac{r}{h} = \frac{3}{4}$

$r : h = 3:4$

**77.** **(d)** Let, the radius of base = $r$ units and the height of cone = $h$ units.

Now, according to the question,

$\therefore \quad 2\pi r^2 = \pi r\sqrt{r^2+h^2}$

$\Rightarrow \quad 2r = \sqrt{r^2+h^2} = 4r^2 = r^2 + h^2$

$\Rightarrow \quad 3r^2 = h^2 \quad \Rightarrow \quad \sqrt{3}r = h$

$\Rightarrow \quad \frac{r}{h} = \frac{1}{\sqrt{3}} \qquad \therefore \quad r:h = 1:\sqrt{3}$

**78.** **(d)** Area of the base $= \frac{\sqrt{3}}{4}\times \text{side}^2$

$= \frac{\sqrt{3}}{4}\times6\times6 = 9\sqrt{3}$ cm$^2$

$\therefore \quad$ Volume of the prism = Area of base × height

$\Rightarrow \quad 108\sqrt{3} = 9\sqrt{3}\times h$

$\Rightarrow \quad h = \frac{108\sqrt{3}}{9\sqrt{3}} = 12$ cm.

**79.** **(a)** Let, the number of required coins be $x$.

Total volume of all coins

$= x\times\pi\times(0.75)^2\times(0.2)$

Volume of cylinder $= \pi\times(3)^2\times8$

Now, according to the question,

$x\times\pi\times(0.75)^2\times(0.2) = \pi\times(3)^2\times8$

$x = \left(\frac{3}{0.75}\right)^2\times\left(\frac{8}{0.2}\right) = 4^2\times40$

= 16 × 40 = 640

Quicker Method:

Number of coins $= \left(\frac{R_2}{R_1}\right)^2\times\left(\frac{h_2}{h_1}\right)$

$= \left(\frac{3}{0.75}\right)^2\times\left(\frac{8}{0.2}\right) = 4^2\times40 = 640$

**80.** **(d)** Let, the radius of the original sphere be $rm$

New radius = $(r + 2)$ m

Now, according to the question,

$4\pi(r+2)^2 - 4\pi r^2 = 704$ m$^2$

$\Rightarrow \quad 4\pi(r^2 + 4r + 4 - r^2) = 704$ m$^2$

$\Rightarrow \quad 16\pi(r + 1) = 704$ m$^2$

$\Rightarrow (r+1) = \frac{704}{16\pi} = \frac{44\times7}{22} = 14$ m

$\therefore \quad r = 14 - 1 = 13$ m

**81.** **(c)** Here,a right circular cylinder is circumscribing a hemisphere such that their bases are common.

Then, Radius of cylinder = Radius of hemisphere = height of cylinder = $r$

$\therefore$ Volume of hemisphere $= \frac{2}{3}\pi r^3$

Volume of cylinder = $pr^2.r = \pi.r^3$

$\therefore \quad$ Required ratio $= \frac{2}{3}:1 = 2:3$

**82.** **(c)** Total volume of three spherical balls

$$= \frac{4}{3}\pi[(1)^2 + (2)^3 + (3)^3] = \left[\frac{4}{3}\pi \times 36\right]\text{cm}^3$$

Wasted material $= \frac{4}{3}\pi \times 36 \times \frac{25}{100}$ cm$^3$

$$= \frac{4}{3}\pi \times 9 \text{ cm}^3$$

$\therefore$ Remaining material $= \frac{4}{3}\pi \times (36 - 9)$

$$= \frac{4}{3}\pi \times 27 = \frac{4}{3}\pi 3^3 \text{ cm}^3$$

$\therefore$ Required radius = 3 cm

[$\because$ Volume of sphere $= \frac{4}{3}\pi 3^3$]

**83.** **(b)** The length of the diagonal of a cube = 6 cm

$\therefore$ $\text{Side} \times \sqrt{3} = 6 \text{ cm}$

$$\Rightarrow \text{Side} = \frac{6}{\sqrt{3}} = 2\sqrt{3} \text{ cm}$$

$\therefore$ $\text{Volume} = (2\sqrt{3})^3 = 24\sqrt{3}$ cm$^3$

**84.** **(c)** Total curved surface area of all four identicalparts = $4\pi r^2$ unit$^2$

Here, there will be eight plane surfaces infour identical parts.

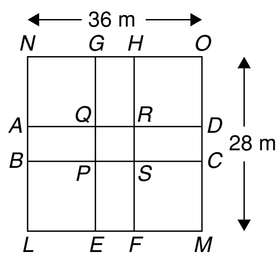
Hence, total plane surface area of four parts

$$= 8 \times \frac{1}{2}\pi r^2 = 4\pi r^2 \text{ unit}^2$$

$\therefore$ Total surface area of four parts

$= 4\pi r^2 + 4\pi r^2 = 8\pi r^2$ unit$^2$

**85.** **(e)**




Area of rectangular plot LMNO= 36 × 28 =1008 m$^2$

Area of paths = Area of ABCD + Area of EFGH − Area of PQRS

= (36 × 5 + 28 × 5) – 5 × 5 = 180 + 140 − 25 = 295 m$^2$

Area of rectangular plot excluding the area covered by roads = 1008 – 295 =713.

Now, total cost of gravelling the plot = 713 × 3.60 = ₹2566.80

**86.** **(c)** Here the edge of an ice cube is 14 cm.

Radius of the cylinder $= \frac{14}{2} = 7$ cm

Height of the cylinder = 14 cm

$\therefore$ Volume of the largest cylinder = $\pi r^2 h$

$$= \frac{22}{7} \times 7 \times 7 \times 14 = 2156 \text{ cm}^3$$

**87.** **(c)** Total flooring area with marble

= locker area + record keeping + pantry

= 182 + 273 + 609 = 1064 m$^2$

Cost of flooring = 1064 × 190

Total flooring area with wood

= Branch manager's room + hall = 221 + 667 = 888 m$^2$

Cost of flooring = 888 × 170

Ratio = (888 × 170):(1064 × 190)

= (888 × 17):(1064 × 19)

= 15096:20216

= 1887:2527

**88.** **(e)** Cost of flooring of the branch manager's room = 221 × 170 = ₹37570

Cost of painting

$$= [2(17 \times 12 + 13 \times 12) + 13 \times 17] \times 190$$

$$= [2(204 + 156) + 221] \times 190 = (2 \times 360 + 221) \times 190$$

$$= (720 + 221) \times 190 = 941 \times 190 = ₹178790$$

Total cost = 178790 + 37570 = ₹216360

**89.** **(e)** Total area of the bank = 2000 m$^2$

Total floor area = 1952 m$^2$

Remaining area = 2000 – 1952 = 48 m$^2$

$\therefore$ Cost of carpeting = 48 × 110 = ₹5280

**90.** **(b)** Area not to be renovated = 48 m$^2$

$\therefore$ $\text{Required\%} = \frac{48}{2000} \times 100 = 2.4\%$

**91.** **(a)** Cost of renovation of hall + locker area = 667 × 170 + 609 × 190

= 113390 + 115710 = ₹229100

# 35 Trigonometric Ratios

## INTRODUCTION

The literal meaning of the word trigonometry is the 'science of triangle measurement'. The word trigonometry is derived from two Greek words trigon and metron which means measuring the sides of a triangle. It had its beginning more than two thousand years ago as a tool for astronomers. The Babylonians, Egyptians, Greeks and the Indians studied trigonometry only because it helped them in unravelling the mysteries of the universe. In modern times, it has gained wider meaning and scope. Presently, it is defined as that branch of mathematics which deals with the measurement of angles, whether of triangle or any other figure.

At present, trigonometry is used in surveying, astronomy, navigation, physics, engineering, etc.

### Important Formulae and Results of Trigonometry

**I.** (i) $180° = \pi$ radians.

(ii) $1° = \dfrac{\pi}{180} = 0.01745$ radians (approximately).

(iii) $\pi = \dfrac{\text{circumference of a cirlce}}{\text{diameter of the circle}}$

$= \dfrac{22}{7} = 3.1416$ (approximately).

(iv) $\theta$ (in radian measure) $= \dfrac{l}{r}$.

(v) Each interior angle of a regular polygon of $n$ sides $= \dfrac{n-2}{n} \times 180$ degrees.

**II.** (i) $\sin\theta \times \text{cosec}\theta = 1$; $\sin\theta = \dfrac{1}{\text{cosec}\,\theta}$; $\text{cosec}\,\theta = \dfrac{1}{\sin\theta}$.

Also, $-1 \le \sin x \le 1$, $\text{cosec}\, x \le -1$ or $\text{cosec}\, x \ge 1$.

(ii) $\cos\theta \times \sec\theta = 1$; $\cos\theta = \dfrac{1}{\sec\theta}$; $\sec\theta = \dfrac{1}{\cos\theta}$.

Also, $-1 \le \cos x \le 1$, $\sec x \le -1$ or $\sec x \ge 1$.

(iii) $\tan\theta \times \cot\theta = 1$; $\tan\theta = \dfrac{1}{\cot\theta}$; $\cot\theta = \dfrac{1}{\tan\theta}$.

Also, $-\infty < \tan\theta < \infty$, $-\infty < \cot\theta < \infty$.

(iv) $\sin^2\theta + \cos^2\theta = 1$; $\sin^2\theta = 1 - \cos^2\theta$; $\cos^2\theta = 1 - \sin^2\theta$

(v) $\sin^2\theta = 1 + \tan^2\theta$; $\sec^2\theta - \tan^2\theta = 1$; $\tan^2\theta = \sec^2\theta - 1$.

(vi) $\text{cosec}^2\theta = 1 + \cot^2\theta$; $\text{cosec}^2\theta - \cot^2\theta = 1$; $\cot^2\theta = \text{cosec}^2\theta - 1$.

(vii) $\tan\theta = \dfrac{\sin\theta}{\cos\theta}$; $\cot\theta = \dfrac{\cos\theta}{\sin\theta}$.

**III. Values of trigonometrical ratios for particular angles**

(i)

| Angle | sine | cos | tan |
|---|---|---|---|
| 0° | 0 | 1 | 0 |
| $30° = \frac{\pi}{6}$ | – | $\frac{\sqrt{3}}{2}$ | $\frac{1}{\sqrt{3}}$ |
| $45° = \frac{\pi}{4}$ | $\frac{1}{\sqrt{2}}$ | $\frac{1}{\sqrt{2}}$ | 1 |
| $60° = \frac{\pi}{3}$ | $\frac{\sqrt{3}}{2}$ | $\frac{1}{2}$ | $\sqrt{3}$ |
| $90° = \frac{\pi}{2}$ | 1 | 0 | $\infty$ |
| $120° = \frac{2\pi}{3}$ | $\frac{\sqrt{3}}{2}$ | $-\frac{1}{2}$ | $-\sqrt{3}$ |
| $135° = \frac{3\pi}{4}$ | $\frac{1}{\sqrt{2}}$ | $-\frac{1}{\sqrt{2}}$ | $-1$ |

| | | | |
|---|---|---|---|
| $150° = \frac{5\pi}{6}$ | $\frac{1}{2}$ | $-\frac{\sqrt{3}}{2}$ | $-\frac{1}{\sqrt{3}}$ |
| $180° = \pi$ | 0 | –1 | 0 |
| $270° = \frac{3\pi}{2}$ | –1 | 0 | $-\infty$ |
| $360° = 2\pi$ | 0 | 1 | 0 |

(ii) $\sin 15° = \dfrac{\sqrt{3}-1}{2\sqrt{2}}$; $\cos 15° = \dfrac{\sqrt{3}+1}{2\sqrt{2}}$;

$\tan 15° = 2-\sqrt{3}$.

(iii) $\sin 18° = \dfrac{\sqrt{5}-1}{4} = \cos 72°$;

$\cos 18° = \dfrac{\sqrt{10+2\sqrt{5}}}{4} = \sin 72°$.

(iv) $\cos 36° = \dfrac{\sqrt{5}+1}{4} = \sin 54°$;

$\sin 35° = \dfrac{\sqrt{10-2\sqrt{5}}}{4} = \cos 54°$.

(v) $\tan 7\dfrac{1°}{2} = (\sqrt{3}-\sqrt{2})(\sqrt{2}-1)$;

$\cot 7\dfrac{1°}{2} = (\sqrt{3}+\sqrt{2})(\sqrt{2}+1)$.

## IV. Signs of trigonometrical ratios

| Angle | sin | cos | tan |
|---|---|---|---|
| $-\theta$ | $-\sin\theta$ | $\cos\theta$ | $-\tan\theta$ |
| $90° - \theta$ or $\frac{\pi}{2} - \theta$ | $\cos\theta$ | $\sin\theta$ | $\cot\theta$ |
| $90° + \theta$ or $\frac{\pi}{2} + \theta$ | $\cos\theta$ | $-\sin\theta$ | $-\cot\theta$ |
| $180° - \theta$ or $\pi - \theta$ | $\sin\theta$ | $-\cos\theta$ | $-\tan\theta$ |
| $180° + \theta$ or $\pi + \theta$ | $-\sin\theta$ | $-\cos\theta$ | $\tan\theta$ |
| $270° - \theta$ or $\frac{3\pi}{2} - \theta$ | $-\cos\theta$ | $-\sin\theta$ | $\cot\theta$ |
| $270° + \theta$ or $\frac{3\pi}{2} + \theta$ | $-\cos\theta$ | $\sin\theta$ | $-\cot\theta$ |
| $360° - \theta$ or $2\pi - \theta$ | $-\sin\theta$ | $\cos\theta$ | $-\tan\theta$ |
| $360° + \theta$ or $2\pi + \theta$ | $-\sin\theta$ | $\cos\theta$ | $\tan\theta$ |

## V. Trigonometrical ratios for sum or difference of angles

(i) $\sin(A \pm B) = \sin A \times \cos B \pm \cos A \times \sin B$.

(ii) $\cos(A \pm B) = \cos A \times \cos B \sin A \times \sin B$.

(iii) $\tan(A \pm B) = \dfrac{\tan A \pm \tan B}{1 \mp \tan A \times \tan B}$.

(iv) $\cot(A \pm B) = \dfrac{\cot A \times \cot B \mp 1}{\cot B \pm \cot A}$.

(v) $\tan(A + B + C)$

$$= \frac{\tan A + \tan B + \tan C - \tan A \tan B \tan C}{1 - (\tan A \tan B + \tan B \tan C + \tan C \tan A)}$$

(vi) $\sin(A + B) \times \sin(A - B) = \sin^2 A - \sin^2 B$.

(vii) $\cos(A + B) \times \cos(A - B) = \cos^2 A - \sin^2 B$.

## VI. Sum or difference of sine or cosine of angles into products

(i) $\sin C + \sin D = 2 \sin \dfrac{C+D}{2} \cos \dfrac{C-D}{2}$.

(ii) $\sin C - \sin D = 2 \cos \dfrac{C+D}{2} \cdot \sin \dfrac{C-D}{2}$.

(iii) $\cos C + \cos D = 2 \cos \dfrac{C+D}{2} \cdot \cos \dfrac{C-D}{2}$.

(iv) $\cos C - \cos D = 2 \sin \dfrac{C+D}{2} \cdot \sin \dfrac{D-C}{2}$,

## VII. Product of sines and cosines of angles into sum or difference of angles

(i) $2 \sin A \cos B = \sin(A + B) + \sin(A - B)$.

(ii) $2 \cos A \sin B = \sin(A + B) - \sin(A - B)$.

(iii) $2 \cos A \cos B = \cos(A + B) + \cos(A - B)$.

(iv) $2 \sin A \sin B = \cos(A - B) - \cos(A + B)$.

## VIII. Trigonometrical ratios of multiple angles

(i) $\sin 2A = 2 \sin A \cos A = \dfrac{2\tan A}{1+\tan^2 A}$.

(ii) $\cos^2 A = \cos^2 A - \sin^2 A = 2\cos^2 A - 1$

$= 1 - 2\sin^2 A = \dfrac{1-\tan^2 A}{1+\tan^2 A}$.

(iii) $\tan 2A = \dfrac{2\tan A}{1-\tan^2 A}$.

(iv) $\sin^2 A = \dfrac{1-\cos 2A}{2}$; $\cos^2 A = \dfrac{1-\cos 2A}{2}$.

(v) $\tan A = \sqrt{\dfrac{1-\cos 2A}{1+\cos 2A}} = \dfrac{1-\cos 2A}{\sin 2A}$.

(vi) $\sin 3A = 3\sin A - 4\sin^3 A$.

(vii) $\cos 3A = 4\cos^3 A - 3\cos A$.

(viii) $\tan 3A = \dfrac{3\tan A - \tan^3 A}{1-3\tan^2 A}$;

$\cot 3A = \dfrac{\cot^3 A - 3\cot A}{3\cot^2 A - 1}$.

**IX. Trigonometrical ratios of submultiple angles**

(i) $\sin A = 2\sin = \dfrac{A}{2}\cos\dfrac{A}{2} = \dfrac{2\tan\frac{A}{2}}{1+\tan^2\frac{A}{2}}$.

(ii) $\cos A = \cos^2\dfrac{A}{2} - \sin^2\dfrac{A}{2} = 2\cos^2\dfrac{A}{2} - 1$

$= 1 - 2\sin 2\dfrac{A}{2} = \dfrac{1-\tan^2\frac{A}{2}}{1+\tan^2\frac{A}{2}}$.

(iii) $\tan A = \dfrac{2\tan\frac{A}{2}}{1\tan^2\frac{A}{2}}$.

(iv) $\sin^2\dfrac{A}{2} = \dfrac{1-\cos A}{2}$; $\cos^2\dfrac{A}{2} = \dfrac{1+\cos A}{2}$

(v) $\tan\dfrac{A}{2} = \sqrt{\dfrac{1-\cos A}{1+\cos A}} = \dfrac{1-\cos A}{\sin A}$.

(vi) $2\sin\dfrac{A}{2} = \pm\sqrt{1+\sin A} \pm \sqrt{1-\sin A}$.

(vii) $2\cos\dfrac{A}{2} = \pm\sqrt{1+\sin A} \mp \sqrt{1-\sin A}$.

## EXERCISE-I

**1.** If $\dfrac{1+\cos A}{1-\cos A} = \dfrac{m^2}{n^2}$, $\tan A =$

(a) $\pm\dfrac{2mn}{m^2+n^2}$ (b) $\pm\dfrac{2mn}{m^2-n^2}$

(c) $\dfrac{m^2+n^2}{m^2-n^2}$ (d) None of these

**2.** If sin 600° cos 30° + cos 120° sin 150° = $k$, then $k$ =

(a) 0 (b) 1

(c) –1 (d) None of these

**3.** If $\cos\theta + \sin\theta = \sqrt{2}\cos\theta$, then $\cos\theta - \sin\theta =$

(a) $\sqrt{2}\sin\theta$ (b) $2\sin\theta$

(c) $-\sqrt{2}\sin\theta$ (d) None of these

**4.** If $\alpha$ lies in the second quadrant, then $\sqrt{\dfrac{1-\sin\alpha}{1+\sin\alpha}} - \sqrt{\dfrac{1+\sin\alpha}{1-\sin\alpha}} =$

(a) $\tan\alpha$ (b) $2\tan\alpha$

(c) $2\cot\alpha$ (d) $\cot\alpha$

**5.** If $\cot\theta + \cos\theta = p$ and $\cot\theta - \cos\theta = 9$, then $(p^2 - q^2)^2$ in terms of $p$ and $q$ is:

(a) 16 $pq$ (b) 8 $pq$

(c) 4 $pq$ (d) 12 $pq$

**6.** If $x = a\,\text{cosec}^n\,\theta$ and $y = b\cot^n\theta$, then by eliminating $\theta$

(a) $\left(\dfrac{x}{a}\right)^{\frac{2}{n}} + \left(\dfrac{y}{b}\right)^{\frac{2}{n}} = 1$ (b) $\left(\dfrac{x}{a}\right)^{\frac{2}{n}} - \left(\dfrac{y}{b}\right)^{\frac{2}{n}} = 1$

(c) $\left(\dfrac{x}{a}\right)^{2} - \left(\dfrac{y}{b}\right)^{2} = 1$ (d) $\left(\dfrac{x}{a}\right)^{\frac{1}{n}} - \left(\dfrac{y}{b}\right)^{\frac{1}{n}} = 1$

**7.** If $\tan\theta = \dfrac{p}{q}$, then $\dfrac{p\sin\theta - q\cos\theta}{p\sin\theta + q\cos\theta} =$

(a) $\dfrac{(p^2+q^2)}{(p^2-q^2)}$ (b) $\dfrac{(p^2-q^2)}{(p^2+q^2)}$

(c) $\dfrac{(p^2+q^2)}{(p^2-q^2)}$ (d) None of these

**8.** If $\sin A = \dfrac{3}{5}$, $\tan B = \dfrac{1}{2}$ and $\dfrac{\pi}{2} < A < \pi < B < \dfrac{3\pi}{2}$, the value of $8\tan A - \sqrt{5}$ see $B$ =

(a) $\dfrac{7}{2}$ (b) $\dfrac{5}{2}$

(c) $-\dfrac{5}{2}$ (d) $-\dfrac{7}{2}$

**9.** If $\sec\theta - \tan\theta = \dfrac{a+1}{a-1}$, then $\cos\theta =$

(a) $\dfrac{a^2+1}{a^2-1}$ (b) $\dfrac{a^2-1}{a^2+1}$

(c) $\dfrac{2a}{a^2+1}$ (d) $\dfrac{2a}{a^2-1}$

**10.** If $\tan 20° = k$, then $\dfrac{\tan 250° + \tan 340°}{\tan 200° - \tan 110°} =$

(a) $\dfrac{1+k}{1-k}$ (b) $\dfrac{1-k}{1+k}$

(c) $\dfrac{1+k^2}{1-k^2}$ (d) $\dfrac{1-k^2}{1+k^2}$

**11.** The value of sin 780°sin 480° + cos 240°cos 300° =

(a) $\dfrac{1}{2}$ (b) $\dfrac{1}{4}$

(c) 1 (d) None of these

**12.** If $\tan\theta + \cot\theta = 2$, then $\sin\theta =$

(a) $\pm\dfrac{1}{2}$ (b) $\dfrac{1}{\sqrt{2}}$

(c) $\pm\dfrac{1}{3}$ (d) None of these

**13.** If $\theta$ is in the first quadrant and $\tan\theta = \dfrac{3}{4}$, then

$$\frac{\tan\left(\dfrac{\pi}{2}-\theta\right) - \sin(\pi-\theta)}{\sin\left(\dfrac{3\pi}{2}+\theta\right) - \cot(2\pi-\theta)} =$$

(a) $\dfrac{8}{11}$ (b) $\dfrac{6}{11}$

(c) $\dfrac{11}{8}$ (d) $\dfrac{11}{6}$

**14.** If $\cot 20° = p$, then $\dfrac{\tan 160° - \tan 110°}{1 + \tan 160° \tan 110°} =$

(a) $\dfrac{p^2-1}{2p}$ (b) $\dfrac{p^2+1}{2p}$

(c) $\dfrac{1-p^2}{2p}$ (d) $\dfrac{2p}{1+p^2}$

**15.** If $A$ lies in the second quadrant and $B$ lies in the third quadrant and $\cos A = -\sqrt{\dfrac{3}{2}}$, $\sin B = -\dfrac{3}{5}$, then $\dfrac{2\tan B + \sqrt{3}\tan A}{\cot^2 A + \cos B} =$

(a) $\dfrac{5}{21}$ (b) $\dfrac{5}{24}$

(c) $\dfrac{5}{22}$ (d) None of these

**16.** The value of $\dfrac{\sin 150° - 5\cos 300° + 7\tan 225°}{\tan 135° + 3\sin 210°}$ is:

(a) 2 (b) 1

(c) –1 (d) –2

**17.** If $f(x) = \cos^2 x + \sec^2 x$, its value always is:

(a) $f(x) < 1$ (b) $f(x) = 1$

(c) $2 > f(x) > 1$ (d) $f(x) \geq 2$

**18.** If $\operatorname{cosec}\theta + \cot\theta = p$, then $\cos\theta =$

(a) $\dfrac{p^2+1}{p^2-1}$ (b) $\dfrac{1+p^2}{1-p^2}$

(c) $\dfrac{p^2-1}{p^2+1}$ (d) $\dfrac{1-p^2}{1+p^2}$

**19.** If $\sin\theta = -\dfrac{7}{25}$ and $\theta$ is in the third quadrant, then $\dfrac{7\cot\theta - 24\tan\theta}{7\cot\theta + 24\tan\theta} =$

(a) $\dfrac{17}{31}$ (b) $\dfrac{16}{31}$

(c) $\dfrac{15}{31}$ (d) None of these

**20.** If $\tan A + \sin A = m$ and $\tan A - \sin A = n$, then $\dfrac{(m^2-n^2)^2}{mn} =$

(a) 4 (b) 3

(c) 16 (d) 9

**21.** If $\operatorname{cosec}\theta - \sin\theta = m$ and $\sec\theta - \cos\theta = n$ then $(m^2n)^{\frac{2}{3}} + (mn^2)^{\frac{2}{3}} =$

(a) –1 (b) 1

(c) 0 (d) None of these

**22.** The value of cos 1°cos 2°cos 3°…cos 179° =

(a) 1 (b) –1

(c) 0 (d) None of these

**23.** Without using trigonometric tables, sin48°sec42° + cos 48°cosec 42° =

(a) 0 (b) 2
(c) 1 (d) None of these

**24.** tan 5°tan 25°tan 45°tan 65°tan 85° =

(a) −1 (b) 1
(c) $\frac{1}{2}$ (d) None of these

**25.** $\cos^2 5° + \cos^2 10° + \cos^2 15° + \cdots + \cos^2 90° =$

(a) $8\frac{1}{2}$ (b) $6\frac{1}{2}$
(c) $7\frac{1}{2}$ (d) None of these

**26.** The value of log tan 1° + log tan 2° +log tan 3° + … + log tan 89° is equal to

(a) 1 (b) 0
(c) 3 (d) None of these

**27.** log sin 1° log sin 2° log sin 3°…log sin 179° =

(a) 0 (b) 1
(c) $\frac{1}{\sqrt{2}}$ (d) None of these

**28.** The value of cos 24° + cos 55° + cos 155° + cos 204° is

(a) 1 (b) −1
(c) 0 (d) None of these

**29.** The value of cos 24° + cos 5° + cos 300° + cos 175° + cos 204° is

(a) 0 (b) $-\frac{1}{2}$
(c) $\frac{1}{2}$ (d) 1

**30.** $\sin^2\theta = \frac{(x+y)^2}{4xy}$ is possible only when

(a) $x > 0, y > 0, x \neq y$
(b) $x > 0, y > 0, x = y$
(c) None of these

**31.** If $7\sin^2\theta + 3\cos^2\theta = 4$, then $\tan\theta =$

(a) $\pm\frac{1}{3}$ (b) $\pm\frac{1}{2}$
(c) $\pm\frac{1}{\sqrt{3}}$ (d) $\pm\frac{1}{\sqrt{2}}$

**32.** If $\tan\alpha = n\tan\beta$ and $\sin\alpha = m\sin\beta$, then $\frac{m^2-1}{n^2-1} =$

(a) $\cos^3\alpha$ (b) $\sin^2\alpha$
(c) $\sin^2\alpha$ (d) $\cos^2\alpha$

**33.** If $\sec A = a + \left(\frac{1}{4a}\right)$, then $\sec A + \tan A =$

(a) $2a$ or $\frac{1}{2a}$ (b) $a$ or $\frac{1}{a}$
(c) $2a$ or $\frac{1}{a}$ (d) $a$ or $\frac{1}{2a}$

**34.** The value of $\frac{\sin^3 A + \cos^3 A}{\sin A + \cos A} + \frac{\cos^3 A - \sin^3 A}{\cos A - \sin A}$ is:

(a) 0 (b) 1
(c) 2 (d) None of these

**35.** The value of tan 20° + tan 40° + tan 60° + ⋯ + tan 180° is

(a) 1 (b) −1
(c) 0 (d) None of these

**36.** If $\cos\theta = \frac{-\sqrt{3}}{2}$ and $\sin\alpha = \frac{-3}{5}$, where $\theta$ does not lie in the third quadrant and $\alpha$ lies in the third quadrant, $\frac{2\tan\alpha + \sqrt{3}\tan\theta}{\cot^2\theta + \cos\alpha} =$

(a) $\frac{5}{22}$ (b) $\frac{-5}{22}$
(c) $\frac{7}{22}$ (d) None of these

**37.** The value of cos 24° + cos 55° + cos 125° + cos 204° + cos 300° is:

(a) $\frac{1}{2}$ (b) $-\frac{1}{2}$
(c) 1 (d) −1

**38.** $\frac{\cot\theta - \operatorname{cosec}\theta + 1}{\cot\theta + \operatorname{cosec}\theta - 1}$ is equal to:

(a) 1 (b) $\cot\theta + \operatorname{cosec}\theta$
(c) $\operatorname{cosec}\theta - \cot\theta$ (d) None of these

**39.** If $90° < \alpha < 180°$, $\sin\alpha = \frac{\sqrt{3}}{2}$

and $180° < \beta < 270°$, $\sin\beta = -\frac{\sqrt{3}}{2}$,

then $\frac{4\sin\alpha - 3\tan\beta}{\tan\alpha + \sin\beta} =$

(a) $\frac{2}{3}$ (b) 0
(c) $-\frac{2}{3}$ (d) None of these

**40.** $\sqrt{\dfrac{1+\cos\theta}{1-\cos\theta}}+\sqrt{\dfrac{1-\cos\theta}{1+\cos\theta}}=$

(a) $2\sin\theta$ (b) $2\cos\theta$

(c) $\dfrac{2}{|\cos\theta|}$ (d) $\dfrac{2}{|\sin\theta|}$

**41.** If $\sqrt{\dfrac{1+\cos\alpha}{1-\cos\alpha}}=\operatorname{cosec}\alpha+\cot\alpha$, then the quadrants in which $\alpha$ lies are:

(a) 1, 4 (b) 2, 3
(c) 1, 2 (d) 3, 4

**42.** If $\operatorname{cosec}\theta - \cot\theta = p$, then the value of $\operatorname{cosec}\theta =$

(a) $\dfrac{1}{2}\left(p+\dfrac{1}{p}\right)$ (b) $\dfrac{1}{2}\left(p-\dfrac{1}{p}\right)$

(c) $p+\dfrac{1}{p}$ (d) $p-\dfrac{1}{p}$

**43.** The value of $\tan 1° \tan 2° \ldots \tan 89°$ is:

(a) $-1$ (b) 1
(c) 0 (d) None of these

**44.** If $\operatorname{cosec}^2\theta=\dfrac{4xy}{(x+y)^2}$, then:

(a) $x = -y$ (b) $x=\dfrac{1}{y}$

(c) $x = y$ (d) None of these

**45.** The value of $\dfrac{\sin 300°\tan 240°\sec(-420°)}{\cot(-315°)\cos(210°)\operatorname{cosec}(-315°)}$ is:

(a) $\sqrt{3}$ (b) $\sqrt{2}$

(c) $\sqrt{6}$ (d) $\sqrt{8}$

**46.** The length of an arc which subtends an angle 18° at the centre of the circle of radius 6 cms is:

(a) $\left(\dfrac{\pi}{5}\right)$ cm (b) $\left(\dfrac{2\pi}{5}\right)$ cm

(c) $\left(\dfrac{3\pi}{5}\right)$ cm (d) None of these

**47.** If $x$ is real and $x+\dfrac{1}{x}=2\cos\theta$, then $\cos\theta =$

(a) $\pm\dfrac{1}{2}$ (b) $\pm\dfrac{1}{3}$

(c) $\pm 1$ (d) None of these

**48.** Which of the following is correct?

(a) $\sin 1° > \sin 1$ (b) $\sin 1° = \sin 1$

(c) $\sin 1° < \sin 1$ (d) $\sin 1°=\left(\dfrac{\pi}{180}\right)\sin 1$

**49.** Which one of the following is true?

(a) $\tan 1 = 1$
(b) $\tan 1 = \tan 2$
(c) $\tan 1 < \tan 2$
(d) $\tan 1 > \tan 2$

**50.** The value of $\cos^2\theta + \sec^2\theta$ is always:

(a) Less than 1
(b) Equal to 1
(c) Lies between 1 and 2
(d) Greater than 2.

**51.** If $\sin\alpha=\dfrac{2pq}{p^2+q^2}$, then $\sec\alpha - \tan\alpha =$

(a) $\dfrac{p-q}{p+q}$ (b) $\dfrac{pq}{p^2+q^2}$

(c) $\dfrac{p+q}{p-q}$ (d) None of these

**52.** If $13\sin A=12$, $\dfrac{\pi}{2}<A<\pi$ and $3\sec B=5$, $\dfrac{3\pi}{2}<B<2\pi$ then $5\tan A+3\tan^2 B=$

(a) $\dfrac{20}{3}$ (b) $-\dfrac{20}{3}$

(c) $\dfrac{22}{3}$ (d) $-\dfrac{22}{3}$

**53.** The value of $\sin 105° + \cos 105°$ is:

(a) $\dfrac{1}{\sqrt{2}}$ (b) $-\dfrac{1}{\sqrt{2}}$

(c) 0 (d) None of these

**54.** If $\tan A=\dfrac{1}{2}$ and $\tan B=\dfrac{1}{3}$, the value of $A$ + B is:

(a) $\dfrac{\pi}{3}$ (b) $\dfrac{\pi}{4}$

(c) $\dfrac{\pi}{2}$ (d) None of these

**55.** If $\tan(A-B)=\dfrac{7}{24}$ and $\tan A=\dfrac{4}{3}$ where $A$ and $B$ are acute, then $A + B =$

(a) $\dfrac{\pi}{2}$ (b) $\dfrac{\pi}{3}$

(c) $\dfrac{\pi}{4}$ (d) None of these

**56.** The value of $\dfrac{(\tan 69°+\tan 66°)}{(1-\tan 69°\tan 66°)}$ is:

(a) 1 (b) 0

(c) 2 (d) −1

**57.** The value of $\sin^2 75° - \sin^2 15°$ is:

(a) $\dfrac{\sqrt{3}}{2}$ (b) $-\dfrac{\sqrt{3}}{2}$

(c) $\dfrac{1}{2}$ (d) None of these

**58.** If

$\sin\alpha=\dfrac{8}{17}$, $0<\alpha<90°$ and $\tan\beta=\dfrac{5}{12}$, $0<\beta<90°$, then $\cos(\alpha-\beta)$ is:

(a) $\dfrac{210}{221}$ (b) $\dfrac{171}{221}$

(c) $\dfrac{220}{221}$ (d) None of these

**59.** The value of $\sin^2\theta + \sin^2(\theta + 60°) + \sin^2(\theta - 60°) =$

(a) $\dfrac{1}{2}$ (b) 0

(c) $\dfrac{3}{2}$ (d) None of these

**60.** If $\tan\alpha=\dfrac{m}{m+1}$ and $\tan\beta=\dfrac{1}{2m+1}$, then $\alpha+\beta=$

(a) $\dfrac{\pi}{3}$ (b) $\dfrac{\pi}{2}$

(c) $\dfrac{\pi}{4}$ (d) None of these

**61.** The value of $\dfrac{1}{\sin 10°}-\dfrac{\sqrt{3}}{\cos 10°}=$

(a) 1 (b) 4

(c) 3 (d) None of these

**62.** The value of $\sqrt{2+\sqrt{2(1+\cos 4A)}}$ is equal to:

(a) $\cos A$ (b) $\sin A$

(c) $2\cos A$ (d) $2\sin A$

**63.** If $\tan A=\dfrac{1-\cos B}{\sin B}$, then $\tan 2A =$

(a) $\tan B$ (b) $\cot B$

(c) $2\tan B$ (d) $2\cot B$

**64.** The value of $\dfrac{\cos 2\theta}{1-\sin 2\theta}=$

(a) $\tan\left(\dfrac{\pi}{4}-\theta\right)$ (b) $\cot\left(\dfrac{\pi}{4}-\theta\right)$

(c) $\tan\left(\dfrac{\pi}{4}+\theta\right)$ (d) $\cot\left(\dfrac{\pi}{4}+\theta\right)$

**65.** The value of $\dfrac{\tan 40°+\tan 20°}{1-\cot 70°\cot 50°}$ is equal to:

(a) $\sqrt{3}$ (b) $\sqrt{2}$

(c) $\dfrac{1}{\sqrt{3}}$ (d) $\dfrac{1}{\sqrt{2}}$

**66.** The value of $\sqrt{3}\operatorname{cosec}20°-\sec 20°=$

(a) 2 (b) 4

(c) 3 (d) None of these

**67.** The value of $\tan 9° - \tan 27° - \tan 63° + \tan 81°$ is:

(a) 2 (b) 3

(c) 4 (d) None of these

**68.** $\tan 5x - \tan 3x - \tan 2x$ is equal to:

(a) $\tan 2x \tan 3x \tan 5x$

(b) $\dfrac{\sin 5x-\sin 3x-\sin 2x}{\cos 5x-\cos 3x-\cos 2x}$

(c) 0

(d) None of these

**69.** If $\tan A=\dfrac{n}{n+1}$ and $\tan B=\dfrac{1}{2n+1}$, the value of $\tan(A + B) =$

(a) − 1 (b) 1

(c) 2 (d) None of these

**70.** If $\sin A=\dfrac{1}{\sqrt{10}}$, $\sin B=\dfrac{1}{\sqrt{5}}$ where $A$ and $B$ are positive and acute, $A + B =$

(a) $\dfrac{\pi}{2}$ (b) $\dfrac{\pi}{4}$

(c) $\dfrac{\pi}{3}$ (d) None of these

**71.** $\dfrac{1+\sin\theta-\cos\theta}{1+\sin\theta+\cos\theta}$ is equal to:

(a) $\cot\left(\dfrac{\theta}{2}\right)$ (b) $\tan\left(\dfrac{\theta}{2}\right)$

(c) $\sec\left(\dfrac{\theta}{2}\right)$ (d) $\operatorname{cosec}\dfrac{\theta}{2}$

**72.** $\tan 7\dfrac{1}{2}^{\circ}$ is equal to:

(a) $\dfrac{2\sqrt{2}-(1+\sqrt{3})}{\sqrt{3}-1}$ (b) $\dfrac{1+\sqrt{3}}{1-\sqrt{3}}$

(c) $\dfrac{1}{\sqrt{3}}+\sqrt{3}$ (d) $2\sqrt{2}+\sqrt{3}$

**73.** If $\dfrac{\cos 3A+\sin 3A}{\cos A-\sin A}=1-K\sin 2A$, the value of $K$ is:

(a) –2 (b) 2

(c) 3 (d) 4

**74.** The value of tan 57° – tan 12° – tan 57°tan 12° =

(a) –1 (b) 1

(c) 0 (d) None of these

**75.** If 180° < $\theta$ < 270°, then the value of $\sqrt{4\sin^4\theta+\sin^2 2\theta}+4\cos^2\left(\dfrac{\pi}{4}-\dfrac{\theta}{2}\right)$ is:

(a) 2 (b) 4

(c) 3 (d) None of these

**76.** The value of tan100° + tan125° + tan100° tan125° =

(a) $\sqrt{3}$ (b) –1

(c) $\dfrac{1}{\sqrt{3}}$ (d) 1

**77.** For all $\theta$, the value of $\sqrt{\dfrac{1+\sin\theta}{1-\sin\theta}}=$

(a) $\sec\theta-\tan\theta$ (b) $(\sec\theta+\tan\theta)^2$

(c) $(\sec\theta-\tan\theta)^2$ (d) $\sec\theta+\tan\theta$

**78.** If $\tan\theta=\dfrac{\cos 15^\circ+\sin 15^\circ}{\cos 15^\circ-\sin 15^\circ}$, then $\theta$ =

(a) $\dfrac{\pi}{4}$ (b) $\dfrac{\pi}{3}$

(c) $\dfrac{\pi}{6}$ (d) $\dfrac{\pi}{2}$

**79.** The value of tan56° – tan11° – tan56° tan11° is:

(a) –1 (b) 0

(c) 1 (d) None of these

**80.** If $A+B=45^\circ$ and $(\cot A-1)(\cot+B-1)=4K$, then $K$ =

(a) $\dfrac{1}{4}$ (b) $\dfrac{1}{8}$

(c) $\dfrac{1}{2}$ (d) None of these

## Exercise-2
## (Based on Memory)

**1.** *ABCD* is a rectangle of which *AC* is a diagonal. The value of $(\tan^2\angle CAD+1)\sin^2\angle BAC$ is:

(a) 2 (b) $\dfrac{1}{4}$

(c) 1 (d) 0

**[SSC, 2014]**

**2.** If $\tan x=(\sin 45^\circ)(\cos 45^\circ)+\sin 30^\circ$, then the value of $x$ is:

(a) 30° (b) 45°

(c) 60° (d) 90°

**[SSC, 2014]**

**3.** For any real values of $\theta$, $\sqrt{\dfrac{\sec\theta-1}{\sec\theta+1}}=?$

(a) $\cot\theta-\text{coses}\,\theta$ (b) $\sec\theta-\tan\theta$

(c) $\operatorname{cosec}\theta-\cot\theta$ (d) $\tan\theta-\sec\theta$

**[SSC, 2014]**

**4.** If the sum and difference of two angles are $\dfrac{\pi\neq}{4}$ and $\dfrac{\pi}{12}$, respectively, then the values of the angles in degree measure are:

(a) 70°, 65° (b) 75°, 60°

(c) 45°, 90° (d) 80°, 55°

**[SSC, 2014]**

**5.** In a $\Delta ABC, \angle B=\dfrac{\pi}{3}, \angle C=\dfrac{\pi}{4}$ and $D$ divides $BC$ internally in the ratio 1:3, then $\dfrac{\sin\angle BAD}{\sin\angle CAD}$ is equal to:

(a) $\frac{1}{\sqrt{2}}$ (b) $\frac{1}{\sqrt{3}}$

(c) $\frac{1}{\sqrt{6}}$ (d) $\sqrt{6}$

**[SSC, 2014]**

**6.** If $\sin 3A = \cos(A - 26°)$, where $3A$ is an acute angle then the value of $A$ is:

(a) 29° (b) 26°

(c) 23° (d) 28°

**[SSC, 2014]**

**7.** Value of $\sec^2\theta - \frac{\sin^2\theta - 2\sin^4\theta}{2\cos^4\theta - \cos^2\theta}$ is:

(a) 1 (b) 2

(c) −1 (d) 0

**[SSC, 2014]**

**8.** If $x = a(\sin\theta + \cos\theta), y = b(\sin\theta - \cos\theta)$, then the value of $\frac{x^2}{a^2} + \frac{y^2}{b^2}$ is:

(a) 0 (b) 1

(c) 2 (d) −2

**[SSC, 2014]**

**9.** If $\sin 5\theta = \cos 20°(0° < \theta < 90°)$, then the value of $\theta$ is:

(a) 4° (b) 22°

(c) 10° (d) 14°

**[SSC, 2014]**

**10.** If $\sin\theta + \cos\theta = \sqrt{2}\cos\theta$, then the value of $(\cos\theta - \sin\theta)$ is:

(a) $\sqrt{3}\cos\theta$ (b) $\sqrt{3}\sin\theta$

(c) $\sqrt{2}\cos\theta$ (d) $\sqrt{2}\sin\theta$

**[SSC, 2013]**

**11.** If $x \sin 45° = y \operatorname{cosec} 30°$, then $\frac{x^4}{y^4}$ is equal to:

(a) $4^3$ (b) $6^3$

(c) $2^3$ (d) $8^3$

**[SSC, 2013]**

**12.** If $\tan\theta + \cot\theta = 2$, then the value of $\tan^{100}\theta + \cot^{100}\theta$ is:

(a) 2 (b) 0

(c) 1 (d) $\sqrt{3}$

**[SSC Assistant Grade III, 2013]**

13 $\frac{\tan\theta}{1-\cot\theta} + \frac{\cot\theta}{1-\tan\theta}$ is equal to:

(a) $1 - \tan\theta - \cot\theta$ (b) $1 + \tan\theta - \cot\theta$

(c) $1 - \tan\theta + \cot\theta$ (d) $1 + \tan\theta + \cot\theta$

**[SSC Assistant Grade III, 2013]**

**14.** If $\sec\theta = x + \frac{1}{4x}(0° < \theta < 90°)$, then $\sec\theta + \tan\theta$ is equal to:

(a) $\frac{x}{2}$ (b) $2x$

(c) $x$ (d) $\frac{1}{2x}$

**[SSC Assistant Grade III, 2013]**

**15.** The circular measure of an angle of an isosceles triangle is $\frac{5\pi}{9}$. Circular measure of one of the other angles must be:

(a) $\frac{5\pi}{18}$ (b) $\frac{5\pi}{9}$

(c) $\frac{2\pi}{9}$ (d) $\frac{4\pi}{9}$

**[SSC Assistant Grade III, 2013]**

**16.** If $x = r\cos\theta\cos\phi$, $y = r\cos\theta\sin\phi$ and $z = r\sin\theta$, then the value of $x^2 + y^2 + z^2$ is:

(a) $r^2$ (b) $r$

(c) $\frac{1}{r^2}$ (d) $\frac{1}{r}$

**[SSC Assistant Grade III, 2012]**

**17.** If $5\cos\theta + 12\sin\theta = 13$, then $\tan\theta = ?$

(a) $\frac{13}{12}$ (b) $\frac{12}{13}$

(c) $\frac{12}{5}$ (d) $\frac{5}{12}$

**[SSC Assistant Grade III, 2012]**

**18.** The value of $\sec^2 12° - \frac{1}{\tan^2 78°}$ is:

(a) 0 (b) 1

(c) 2 (d) 3

**[SSC Assistant Grade III, 2012]**

**19.** If $\tan\theta.\cos 60° = \frac{\sqrt{3}}{2}$, then the value of $\sin(\theta - 15°)$ is:

(a) $\frac{\sqrt{3}}{2}$ (b) $\frac{1}{2}$

(c) 1 (d) $\frac{1}{\sqrt{2}}$

**[SSC Assistant Grade III, 2012]**

**20.** If $\theta$ is a positive acute angle and tan2θ· tan3θ = 1, then the value of $\left(2\cos^2\frac{50}{2}-1\right)$ is:

(a) $-\frac{1}{2}$ (b) 1
(c) 0 (d) $\frac{1}{2}$

**[SSC, 2012]**

**21.** If $\sin 17° = \frac{x}{y}$, then the value of (sec 17° – sin 73°) is:

(a) $\frac{y^2}{x\sqrt{y^2-x^2}}$ (b) $\frac{x^2}{y\sqrt{y^2-x^2}}$
(c) $\frac{x^2}{y\sqrt{x^2-y^2}}$ (d) $\frac{y^2}{x\sqrt{x^2-y^2}}$

**[SSC, 2012]**

**22.** In a right-angled triangle *XYZ*, right-angled at *Y*, if $XY = 2\sqrt{6}$ and *XZ*−*YZ* = 2, then sec *X* + tan *X* is:

(a) $\frac{1}{\sqrt{6}}$ (b) $\sqrt{6}$
(c) $2\sqrt{6}$ (d) $\frac{\sqrt{6}}{2}$

**[SSC, 2012]**

**23.** If 0 < $\theta$ < 90°, the value of sin $\theta$ + cos $\theta$ is:

(a) Equal to 1 (b) Greater than 1
(c) Less than 1 (d) Equal to 2

**[SSC, 2012]**

**24.** The expression $\frac{\tan 57° + \cot 37°}{\tan 33° + \cot 53°}$ is equal to:

(a) tan 33°cot 57°
(b) tan 57°cot 37°
(c) tan 33°cot 53°
(d) tan 53°cot 37°

**[SSC, 2012]**

**25.** The minimum value of $\sin^2\theta + \cos^2\theta + \sec^2\theta + \text{cosec}^2\theta + \tan^2\theta + \cot^2\theta$ is:

(a) 1 (b) 3
(c) 5 (d) 7

**[SSC, 2012]**

**26.** If $2\sin\left(\frac{\pi}{2}\right) = x^2 + \frac{1}{x^2}$, then the value of $\left(x - \frac{1}{x}\right)$ is:

(a) –1 (b) 2
(c) 1 (d) 0

**[SSC, 2012]**

**27.** If $\sin^2\alpha + \sin^2\beta = 2$, then the value of $\cos\left(\frac{\alpha+\beta}{2}\right)$ is:

(a) 1 (b) −1
(c) 0 (d) 0.5

**[SSC, 2011]**

**28.** The value of $\cot\frac{\pi}{20}\cot\frac{3\pi}{20}\cot\frac{5\pi}{20}\cot\frac{7\pi}{20}\cot\frac{9\pi}{20}$ is:

(a) −1 (b) $\frac{1}{2}$
(c) 0 (d) 1

**[SSC, 2011]**

**29.** If $\sin\theta + \cos\theta = \frac{17}{23}, 0 < \theta < 90°$, then the value of $\sin\theta - \cos\theta$ is

(a) $\frac{5}{17}$ (b) $\frac{3}{19}$
(c) $\frac{7}{10}$ (d) $\frac{7}{13}$

**[SSC, 2011]**

**30.** If $\tan\theta \cdot \tan 2\theta = 1$, then the value of $\sin^2 2\theta + \tan^2 2\theta$ is equal to

(a) $\frac{3}{4}$ (b) $\frac{10}{3}$
(c) $3\frac{3}{4}$ (d) 3

**[SSC, 2011]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (c) | **3.** (a) | **4.** (b) | **5.** (a) | **6.** (b) | **7.** (b) | **8.** (d) | **9.** (b) | **10.** (d) | **11.** (a) | **12.** (b) |
| **13.** (c) | **14.** (a) | **15.** (c) | **16.** (d) | **17.** (d) | **18.** (c) | **19.** (a) | **20.** (c) | **21.** (b) | **22.** (c) | **23.** (b) | **24.** (b) |
| **25.** (a) | **26.** (b) | **27.** (a) | **28.** (c) | **29.** (c) | **30.** (b) | **31.** (c) | **32.** (a) | **33.** (b) | **34.** (b) | **35.** (a) | **36.** (a) |
| **37.** (a) | **38.** (c) | **39.** (a) | **40.** (d) | **41.** (a) | **42.** (c) | **43.** (b) | **44.** (c) | **45.** (c) | **46.** (c) | **47.** (c) | **48.** (c) |
| **49.** (b) | **50.** (d) | **51.** (a) | **52.** (b) | **53.** (a) | **54.** (b) | **55.** (a) | **56.** (d) | **57.** (c) | **58.** (c) | **59.** (c) | **60.** (c) |
| **61.** (b) | **62.** (c) | **63.** (d) | **64.** (b) | **65.** (c) | **67.** (b) | **68.** (c) | **69.** (c) | **70.** (c) | **71.** (c) | **72.** (d) | **73.** (a) |
| **74.** (b) | **75.** (a) | **76.** (d) | **77.** (d) | **78.** (b) | **79.** (c) | **80.** (c) | | | | | |

### Exercise-2

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (b) | **3.** (c) | **4.** (b) | **5.** (c) | **6.** (a) | **7.** (a) | **8.** (c) | **9.** (d) | **10.** (d) | **11.** (a) | **12.** (a) |
| **13.** (d) | **14.** (b) | **15.** (c) | **16.** (a) | **17.** (c) | **18.** (b) | **19.** (d) | **20.** (c) | **21.** (b) | **22.** (b) | **23.** (b) | **24.** (b) |
| **25.** (c) | **26.** (d) | **27.** (c) | **28.** (d) | **29.** (d) | **30.** (c) | | | | | | |

## EXPLANATORY ANSWERS

### Exercise-1

**1. (b)** $n^2 + n^2\cos A = nm - m^2\cos A$

$$\Rightarrow \quad \cos A = \frac{m^2-n^2}{m^2+n^2}$$

$$\sin^2 A = 1-\cos^2 A = 1-\frac{(m^2-n^2)^2}{(m^2+n^2)^2} = \frac{4m^2n^2}{(m^2+n^2)^2}$$

$$\Rightarrow \quad \sin A = \pm\frac{2mn}{m^2+n^2}$$

$$\therefore \quad \tan A = \pm\frac{2mn}{m^2-n^2}.$$

**2. (c)** $K = \sin 240°\cos 30° + \cos 120°\sin 150°$

$= -\sin 60°\cos 30° + (-\cos 60°)(\sin 30°)$

$$= -\left(\frac{\sqrt{3}}{2}\right)\left(\frac{\sqrt{3}}{2}\right)+\left(-\frac{1}{2}\right)\left(\frac{1}{2}\right)$$

$$= -\frac{3}{4}-\frac{1}{4} = -1.$$

**3. (a)** Given $\sin\theta = \sqrt{2}\cos\theta - \cos\theta$

$= (\sqrt{2}-1)\cos\theta$

$$\Rightarrow \quad \cos\theta = \frac{1}{\sqrt{2}-1}\sin\theta = \frac{(\sqrt{2}+1)\sin\theta}{(\sqrt{2}-1)(\sqrt{2}+1)}$$

$$= \sqrt{2}\sin\theta + \sin\theta$$

$$\Rightarrow \quad \cos\theta - \sin\theta = \sqrt{2}\sin\theta.$$

**4. (b)** The given expression

$$= \frac{(1-\sin\alpha)-(1+\sin\alpha)}{\sqrt{1-\sin^2\alpha}} = \frac{-2\sin\alpha}{|\cos\alpha|}$$

$$= \frac{-2\sin\alpha}{-\cos\alpha} \quad \left[\because \ \frac{\pi}{2} < \alpha < \pi\right]$$

$= 2\tan\alpha.$

**5. (a)** $p^2 - q^2 = 4\cos\theta\cot\theta = 4\dfrac{\cos^2\theta}{\sin\theta}$

$$\Rightarrow \quad (p^2-q^2)^2 = 16\frac{\cos^4\theta}{\sin^2\theta}$$

$$pq = \cot^2\theta - \cos^2\theta = \cos^2\theta\left(\frac{1-\sin^2\theta}{\sin^2\theta}\right) = \frac{\cos^4\theta}{\sin^2\theta}$$

$$\therefore \quad (p^2-q^2)^2 = 16pq.$$

**6. (b)** $\operatorname{cosec}\theta = \left(\dfrac{x}{a}\right)^{1/n}$, $\cot\theta = \left(\dfrac{y}{b}\right)^{1/n}$

But $\operatorname{cosec}^2\theta - \cot^2\theta = 1$

$$\Rightarrow \left(\frac{x}{a}\right)^{2/n} - \left(\frac{y}{b}\right)^{2/n} = 1.$$

**7. (b)** $\frac{\sin\theta}{\cos\theta} = \frac{p}{q} \Rightarrow \frac{p\sin\theta}{q\cos\theta} = \frac{p^2}{q^2}$

$$\frac{p\sin\theta - q\cos\theta}{p\sin\theta + q\sin\theta} = \frac{p^2 - q^2}{p^2 + q^2}.$$

**8. (d)** $\sin A = \frac{3}{5} \Rightarrow \tan A = -\frac{3}{4} \quad \left[\because \frac{\pi}{2} < A < \pi\right]$

$$\tan B = \frac{1}{2}, \ \sec B = -\frac{\sqrt{5}}{2}$$

$$\therefore \ 8\tan A - \sqrt{5}\sec B = 8\left(\frac{-3}{4}\right) - \sqrt{5}\left(\frac{-\sqrt{5}}{2}\right)$$

$$= -6 + \frac{5}{2} = -\frac{7}{2}.$$

**9. (b)** $\sec\theta - \tan\theta = \frac{a+1}{a-1}$

$$\Rightarrow \ \sec\theta + \tan\theta = \frac{a-1}{a+1}$$

$$\Rightarrow \ \sec\theta + \tan\theta = \frac{a-1}{a+1}$$

Adding, $2\sec\theta = \frac{(a+1)^2 + (a-1)^2}{a^2 - 1} = \frac{2(a^2+1)}{a^2-1}$

$$\Rightarrow \ \sec\theta = \frac{a^2+1}{a^2-1}$$

$$\therefore \ \cos\theta = \frac{a^2-1}{a^2+1}.$$

**10. (d)** $\frac{\tan(270° - 20°) + \tan(360° - 20°)}{\tan(180° + 20°) - \tan(90° + 20°)}$

$$= \frac{\cot 20° - \tan 20°}{\tan 20° + \cot 20°} = \frac{\frac{1}{k} - k}{k + \frac{1}{k}} = \frac{1-k^2}{k^2+1}.$$

**11. (a)** sin 780°sin 480° + cos 240°cos 300°

= sin 60°sin 60° − cos 60°cos 60°

$$= \left(\frac{\sqrt{3}}{2}\right)\left(\frac{\sqrt{3}}{2}\right) - \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)$$

$$= \frac{3}{4} - \frac{1}{4} = \frac{2}{4} = \frac{1}{2}.$$

**12. (b)** $\tan^2\theta - 2\tan\theta + 1 = 0$

$$\Rightarrow \ (\tan\theta - 1)^2 = 0$$

$$\Rightarrow \ \tan\theta = 1 \ \Rightarrow \ \theta = \frac{\pi}{4}$$

$$\therefore \ \sin\theta = \sin\frac{\pi}{4} = \frac{1}{\sqrt{2}}.$$

**13. (c)** $\frac{\cot\theta - \sin\theta}{-\cos\theta + \cot\theta}$

$$= \frac{\left(\frac{4}{3}\right) - \left(\frac{3}{5}\right)}{-\left(\frac{4}{5}\right) + \left(\frac{4}{3}\right)} \quad \left[\begin{array}{l} \therefore \theta < 90° \text{ and } \tan\theta = \frac{3}{4} \\ \sin\theta = \frac{3}{5}, \ \cos\theta = \frac{4}{5} \end{array}\right]$$

$$= \frac{11}{8}.$$

**14. (a)** $\frac{\tan 160° - \tan 110°}{1 + \tan 160° \tan 110°}$

$$= \frac{\tan(180° - 20°) - \tan(90° + 20°)}{1 + \tan(180° - 20°)\tan(90° + 20°)}$$

$$= \frac{-\tan 20° + \cot 20°}{1 + (-\tan 20°)(-\cot 20°)}$$

$$= \frac{-\frac{1}{p+p}}{\frac{1+1}{p \times p}}$$

$$= \frac{p^2 - 1}{2p}. \quad (\because \ \cot 20° = p)$$

**15. (c)** $A$ lies in second quadrant, $\tan A = -\frac{1}{\sqrt{3}}$ $B$ lies in third quadrant, $\tan B = \frac{3}{4}$, $\cos B = -\frac{4}{5}$

$$\therefore \ \frac{2\tan B + \sqrt{3}\tan A}{\cot^2 A + \cos B} = \frac{2\left(\frac{3}{4}\right) + \sqrt{3}\left(-\frac{1}{\sqrt{3}}\right)}{(-\sqrt{3})^2 + \left(-\frac{4}{5}\right)}$$

$$= \frac{\frac{3}{2} - 1}{3 - \frac{4}{5}} = \frac{5}{22}.$$

**16. (d)** $\frac{\sin 150° - 5\cos 300° + 7\tan 225°}{\tan 135° + 3\sin 210°}$

$$= \frac{\sin(180° - 30°) - 5\cos(360° - 60°) + 7\tan(180° + 45°)}{\tan(180° - 45°) + 3\sin(180° + 30°)}$$

$$= \frac{\sin 30° - 5\cos 60° + 7\tan 45°}{-\tan 45° - 3\sin 30°} = \frac{\frac{1}{2} - \frac{5}{2} + 7}{-1 - \frac{3}{2}} = -2.$$

**17. (d)** $f(x) = \cos^2 x + \sec^2 x = (\cos x - \sec x)^2 + 2$

$$\Rightarrow \ f(x) \geq 2.$$

**18.** **(c)** Given cosec$\theta$ + cot$\theta$ = $p$

$\Rightarrow \quad \text{cosec}\theta - \cot\theta = \frac{1}{p}$

$\Rightarrow \quad \text{cosec}\theta = \frac{1}{2}\left(p + \frac{1}{p}\right) = \frac{p^2+1}{2p}$

$\cot\theta = \frac{p^2-1}{2p}$

$\therefore \quad \cos\theta = \frac{\cot\theta}{\text{cosec}\theta} = \frac{p^2-1}{p^2+1}.$

**19.** **(a)** Given $180° < \theta < 270° \quad \Rightarrow \quad \tan\theta = \frac{7}{24}$

$\therefore \quad \frac{7\cot\theta - 24\tan\theta}{7\cot\theta + 24\tan\theta} = \frac{7\left(\frac{24}{7}\right) - 24\left(\frac{7}{24}\right)}{7\left(\frac{24}{7}\right) + 24\left(\frac{7}{24}\right)}$

$= \frac{24-7}{7+24} = \frac{17}{31}.$

**20.** **(c)** $\frac{(m^2-n^2)^2}{mn} = \frac{(4\tan A \sin A)^2}{\tan^2 A - \sin^2 A}$

$= \frac{16\sin^4 A}{\cos^2 A} \cdot \frac{\cos^2 A}{\sin^2 A(1-\cos^2 A)}$

$= \frac{16\sin^4 A}{\sin^2 A \sin^2 A} = 16.$

**21.** **(b)** $m = \frac{1-\sin^2\theta}{\sin\theta} = \frac{\cos^2\theta}{\sin\theta}$

$n = \frac{1-\cos^2\theta}{\cos\theta} = \frac{\sin^2\theta}{\cos\theta}$

$(m^2n)^{2/3} + (mn^2)^{2/3}$

$= \left(\frac{\cos^4\theta}{\sin^2\theta} \cdot \frac{\sin^2\theta}{\cos\theta}\right)^{2/3} + \left(\frac{\cos^2\theta}{\sin\theta} \cdot \frac{\sin^4\theta}{\cos^2\theta}\right)^{2/3}$

= $\cos^2\theta + \sin^2\theta$

= 1.

**22.** **(c)** cos 1°cos 2°cos 3°…cos 179°

= cos 1°cos 2°cos 3°…cos 90°…cos 178°cos 179°

[$\therefore$ cos 90° = 0]

= 0.

**23.** **(b)** sin(90° − 42°)sec42° + cos(90° − 42°)cosec42°

= cos 42°sec 42° + sin 42°cosec 42°

= 1 + 1 = 2.

**24.** **(b)** tan 5°tan 25°tan 45°tan 65°tan 85°

= tan 5°tan 25°·1·tan(90° − 25°)tan(90° − 50°)

= tan 5°tan 25°·1·cot 25°cot 5°

= 1.

**25.** **(a)** $\cos^2 5° + \cos^2 10° + \cos^2 15° + \cdots + \cos^2 90°$

= $(\cos^2 5° + \cos^2 85°) + (\cos^2 10° + \cos^2 80°) + \cdots + (\cos^2 40° + \cos^2 50°) + \cos^2 45° + \cos^2 90°$

= (1 + 1 + … 8 times) $+\frac{1}{2} + 0$

$= 8\frac{1}{2}.$

**26.** **(b)** log(tan 1°tan 2°tan 3°…tan 88°tan 89°)

= log(tan 1°tan 89°)(tan 2°tan 88°)…tan 45°

= log(tan 1°cot 1°)(tan 2°cot 2°)…tan 45°

= log(1·1·1·…1) = log1 = 0.

**27.** **(a)** log sin1°log sin 2°…log sin 90°…log sin 179°

= logsin1°log sin 2°…(0)log sin 91°…log sin 179°

= 0.

**28.** **(c)** cos 24° + cos 55° + cos 155° + cos 204°

= cos 24° + cos 55° + cos(180° − 25°) + cos(180° + 24°)

= cos 24° + cos 55° − cos 25° − cos 24° = 0.

**29.** **(c)** cos 24° + cos 5° + cos 300° + cos 175° + cos 204°

= cos 24° + cos 5° + cos(360° − 60°) + cos(180° − 5°) + cos(180° + 24°)

= cos 24° + cos 5° + cos 60° − cos 5° − cos 24°

$= \frac{1}{2}.$

**30.** **(b)** $\sin^2\theta \ge 1 \quad \Rightarrow \quad \frac{(x+y)^2}{4xy} \ge 1$

$\Rightarrow \quad (x+y)^2 \ge 4xy$

$\Rightarrow \quad (x+y)^2 - 4xy \ge 0$

$\Rightarrow \quad (x-y)^2 \ge 0$

$(x - y)^2 >$ is true.

But $(x - y)^2 = 0$ is true only when $x = y$.

**31.** **(c)** Dividing by $\cos^2\theta$

7 $\tan^2\theta$ + 3 = 4 $\sec^2\theta$

$\Rightarrow \quad 7\tan^2\theta + 3 = 4(1+\tan^2\theta)$

$\Rightarrow \quad 3\tan^2\theta = 1$

$\Rightarrow \quad \tan^2\theta = \frac{1}{3} \quad \Rightarrow \quad \tan\theta = \pm\frac{1}{\sqrt{3}}.$

**32.** **(d)** $m^2 - 1 = \frac{\sin^2\alpha - \sin^2\beta}{\sin^2\beta}$

$n^2 - 1 = \frac{\tan^2\alpha - \tan^2\beta}{\tan^2\beta}$

$= \frac{\sin^2\alpha\cos^2\beta - \sin^2 13\cos^2\alpha}{\cos^2\alpha\cos^2\beta} \times \frac{\cos^2\alpha}{\sin^2\beta}$

$$= \frac{\sin^2\alpha(1-\sin^2\beta)-\sin^2\beta(1-\sin^2\alpha)}{\sin^2\beta\cos^2\alpha}$$

$$= \frac{\sin^2\alpha-\sin^2\beta}{\sin^2\beta\cos^2\alpha}$$

$$\therefore \quad \frac{m^2-1}{n^2-1} = \frac{\sin^2\alpha\sin^2\beta}{\sin^2\beta} \times \frac{\cos^2\alpha\sin^2\beta}{\sin^2\alpha-\sin^2\beta}$$

$= \cos^2\alpha.$

**33.** **(a)** $\tan^2 A = \sec^2 A - 1 = \left(a + \frac{1}{4a}\right)^2 - 1$

$$= \left(a - \frac{1}{4a}\right)^2$$

$$\Rightarrow \quad \tan A = \pm\left(a - \frac{1}{4a}\right)$$

$$\therefore \quad \sec A + \tan A = a + \frac{1}{4a} + a - \frac{1}{4a}$$

or, $a + \frac{1}{4a} - a + \frac{1}{4a} = 2a$ or $\frac{1}{2a}$.

**34.** **(c)** $\frac{\sin^3 A + \cos^3 A}{\sin A + \cos A} + \frac{\cos^3 A - \sin^3 A}{\cos A - \sin A}$

$$= \frac{(\sin A + \cos A)(\sin^2 A + \cos^2 A + \sin A\cos A)}{\sin A + \cos A}$$

$$+ \frac{(\cos A - \sin A)(\cos^2 A + \sin^2 A + \sin A\cos A)}{\cos A - \sin A}$$

$= 2(\sin^2 A + \cos^2 A) = 2.$

**35.** **(c)** tan 20° + tan 40° + tan 60° + … + tan 180°

= tan 20° + tan 40° + ⋯ + tan(180° − 40°) + tan(180° − 20°) + tan 180°

= tan 20° + tan 40° + … + tan(180° − 40°) + tan(180° − 20°) + 0

= tan 20° + tan 40° + … −tan 40° − tan 20°

= (tan 20° − tan 20°) + (tan 40° − tan 40°) + ⋯

= 0 + 0 + … = 0.

**36.** **(a)** $\cos\theta = -\frac{\sqrt{3}}{2} \cdot 90° < \theta < 180°$

$$\Rightarrow \quad \tan\theta = -\frac{1}{\sqrt{3}}$$

and, $\sin\alpha = \frac{-3}{5}$ and $180° < \alpha < 270°$

$$\Rightarrow \quad \tan\alpha = \frac{3}{4}, \ \cos\alpha = \frac{-4}{5}$$

$\therefore$ Given expression $= \dfrac{2\left(\frac{3}{4}\right) + \sqrt{3}\left(-\frac{1}{\sqrt{3}}\right)}{(-\sqrt{3})^2 + \left(-\frac{4}{5}\right)}$

$$= \frac{\frac{1}{2}}{\frac{11}{5}} = \frac{5}{22}.$$

**37.** **(a)** Given expression

= cos 24° + cos 55° − cos 55° − cos 24° + cos 60°

$= \frac{1}{2}.$

**38.** **(c)** Given expression

$$= \frac{(\cot\theta - \operatorname{cosec}\theta) + (\operatorname{cosec}^2\theta - \cot\theta)}{\cot\theta + \operatorname{cosec}\theta - 1}$$

$$= \frac{(\operatorname{cosec}\theta - \cot\theta)[\operatorname{cosec}\theta + \cot\theta - 1]}{\cot\theta + \operatorname{cosec}\theta - 1}$$

$= \operatorname{cosec}\theta - \cot\theta.$

**39.** **(a)** Given $\sin\alpha = \frac{\sqrt{3}}{2}$, $90° < \alpha < 180°$

$$\Rightarrow \quad \tan\alpha = -\sqrt{3}$$

and, $\sin\beta = -\frac{\sqrt{3}}{2}$, $180° < \beta < 270° \quad \Rightarrow \quad \tan\beta = \sqrt{3}$

Given expression $= \dfrac{4\left(\frac{\sqrt{3}}{2}\right) - 3(\sqrt{3})}{-\sqrt{3} - \left(\frac{\sqrt{3}}{2}\right)}$

$$= \frac{-\sqrt{3}(2)}{-3\sqrt{3}} = \frac{2}{3}.$$

**40.** **(d)** Given expression $= \dfrac{1 + \cos\theta + 1 - \cos\theta}{\sqrt{1 - \cos^2\theta}}$

$$= \frac{2}{|\sin\theta|}.$$

**42.** **(a)** Given $\operatorname{cosec}\theta - \cot\theta = p$

$$\Rightarrow \quad \operatorname{cosec}\theta + \cot\theta = \frac{1}{p}$$

$$\Rightarrow \quad 2\operatorname{cosec}\theta = p + \frac{1}{p}$$

$$\therefore \quad \operatorname{cosec}\theta = \frac{1}{2}\left(p + \frac{1}{p}\right).$$

**43.** **(b)** Given expression = tan1°tan 2°…tan 45°…tan 88°tan 89°

= tan1°tan 2°…1…tan(90° − 2°)tan(90° − 1°)

= (tan1°cot1°)(tan 2°cot 2°)…1

= 1·1·1·…1 = 1.

**44.** **(c)** We know that

$$\operatorname{cosec}^2\theta \ge 1 \quad \Rightarrow \quad \frac{4xy}{(x+y)^2} \ge 1$$

$\Rightarrow \quad 4xy-(x+y)^2 \geq 0$

$\Rightarrow \quad -(x-y)^2 \geq 0 \quad \Rightarrow \quad (x-y)^2 \leq 0$

But $(x - y)^2$ cannot be negative

$\therefore$ $(x - y)2 = 0$ is possible only when $x = y$

**45.** **(c)** Given expression

$$=\frac{\sin(360°-60°)\tan(270°-30°)\sec(360°+60°)}{[-\cot(270°+45°)]\cos(180°+30°)[-\text{cosec}(270°+45°)]}$$

$$=\frac{(-\sin 60°)(\cot 30°)(\sec 60°)}{(\tan 45°(-\cos 30°)(\sec 45°)}$$

$$=\frac{-\left(\frac{\sqrt{3}}{2}\right)(\sqrt{3})(2)}{(1)\left(-\frac{\sqrt{3}}{2}\right)(\sqrt{2})}=\frac{6}{\sqrt{6}}=\sqrt{6}.$$

**46.** **(c)** We have $l = r\theta$, where $\theta$ is in radians

Given: $\theta = 18° = 18° \times \frac{\pi}{180°} = \frac{\pi}{10}$ radians

$\therefore$ Length of the arc $= 6\left(\frac{\pi}{10}\right) = \frac{3\pi}{5}.$

**47.** **(c)** Given $x + \frac{1}{x} = 2\cos\theta$

$\Rightarrow \quad x^2 - 2x\cos\theta + 1 = 0$

Since $x$ is real, discriminant $\geq 0$

$\Rightarrow \quad 4\cos^2\theta - 4 \geq 0$

$\Rightarrow \quad \cos^2\theta \geq 1 \quad \Rightarrow \quad \cos\theta = \pm 1$

As $\cos\theta$ cannot be $> 1$ or $< -1$, $\cos\theta = \pm 1$.

**48.** **(c)** $1^c = \frac{180}{\pi} = \frac{180 \times 7}{22} = 57°$ (approx.)

$\Rightarrow \quad \sin 1 = \sin 57°$

$\therefore \quad \sin 45° < \sin 1 < \sin 60° \quad \Rightarrow \quad \frac{1}{\sqrt{2}} < \sin 1 < \frac{\sqrt{3}}{2}$

$\Rightarrow \quad 0.7 < \sin 1 < 0.8$

Also, $\sin 0° < \sin 1° < \sin 30° \quad \Rightarrow \quad 0 < \sin 1° < 0.5$

$\therefore \quad \sin 1° < \sin 1.$

**49.** **(d)** $1^c = \frac{180}{\pi} = 57°$ (approx.)

$\Rightarrow \quad \tan 1 = \tan 57° > 0$

Also, $\tan 2 = \tan 114° < 0$

$\therefore \quad \tan 1 > \tan 2.$

**50.** **(d)** $\cos^2\theta + \sec^2\theta = (\cos\theta - \sec\theta)^2 + 2\cos\theta\sec\theta$

$= (\cos\theta - \sec\theta)^2 + 2$

As $(\cos\theta - \sec\theta)^2$ being a perfect square is always positive, $\cos^2\theta + \sec^2\theta$ is always greater than 2.

**51.** **(a)** Given $\sin\alpha = \frac{2pq}{p^2+q^2}$

$\Rightarrow \quad \sec\theta = -\frac{p^2+q^2}{p^2-q^2}$, $\tan\alpha = \frac{2pq}{p^2-q^2}$

Given expression $= \frac{p^2+q^2}{p^2-q^2} - \frac{2pq}{p^2-q^2}$

$= \frac{(p-q)^2}{p^2-q^2} = \frac{p-q}{p+q}.$

**52.** **(b)** Given $\sin A = \frac{12}{13}$, $A$ lies in the second quadrant and

$\sec B = \frac{5}{3}$, $B$ lies in the fourth quadrant.

$\Rightarrow \quad \tan A = \frac{12}{5} \tan B = -\frac{4}{3}$

Given expression $= 5\left(-\frac{12}{5}\right) + 3\left(\frac{16}{9}\right)$

$= -12 + \frac{16}{3} = -\frac{20}{3}.$

**53.** **(a)** Give expression

$$= \frac{\sqrt{3}+1}{2\sqrt{2}} + \frac{1-\sqrt{3}}{2\sqrt{2}} = \frac{1}{\sqrt{2}}.$$

**54.** **(b)** $\tan(A+B) = \dfrac{\frac{1}{2}+\frac{1}{3}}{1-\left(\frac{1}{2}\right)\left(\frac{1}{3}\right)}$

$$= \frac{\frac{5}{6}}{\frac{5}{6}} = 1$$

$\Rightarrow \quad A + B = \frac{\pi}{4}.$

**55.** **(a)** $\frac{\tan A - \tan B}{1 + \tan A \tan B} = \frac{7}{24} \quad \Rightarrow \quad \dfrac{\frac{4}{3} - \tan B}{1 + \frac{4}{3}\tan B} = \frac{7}{24}$

$\Rightarrow \quad \tan B = \frac{3}{4}$

$\cot\left(A + B = \frac{\cot A \cot + B - 1}{\cot B + \cot A}\right)$

$$= \frac{\left(\frac{3}{4}\right)\left(\frac{4}{3}\right) - 1}{\left(\frac{4}{3}\right) + \left(\frac{3}{4}\right)} = 0$$

$\Rightarrow \quad A + B = \frac{\pi}{2}.$

**56.** (d) Given expression = tan(69° + 66°)

= tan(135°)

= tan(180° − 45°)

= − tan45° = − 1.

**57.** **(a)** Given expression

= sin(75° + 15°)sin(75° − 15°)

= sin 90°sin 60°

$$=1\times\frac{\sqrt{3}}{2}=\frac{\sqrt{3}}{2}.$$

**58.** **(c)** $\cos\alpha=\frac{15}{17}, \cos\beta=\frac{12}{13}, \sin\beta=\frac{5}{13}$

$$\therefore\quad \cos(\alpha-\beta)=\cos\alpha\cos\beta+\sin\alpha\sin\beta$$

$$=\left(\frac{15}{17}\right)\left(\frac{12}{13}\right)+\left(\frac{8}{17}\right)\left(\frac{5}{13}\right)$$

$$=\frac{220}{221}.$$

**59.** **(c)** Given expression

$$=\sin^2\theta+(\sin\theta\cos 60°+\cos\theta\sin 60°)^2$$
$$+(\sin\theta\cos 60°-\cos\theta\sin 60°)^2$$

$$=\sin^2\theta+2(\sin^2\theta\cos^2 60°+\cos^2\theta\sin^2 60°)$$

$$=\sin^2\theta+\frac{1}{2}\sin^2\theta+\frac{3}{2}\cos^2\theta$$

$$=\frac{3}{2}(\sin^2\theta+\cos^2\theta)=\frac{3}{2}.$$

**60.** **(c)** $\tan(\alpha+\beta)=\dfrac{\dfrac{m}{m+1}+\dfrac{1}{2m+1}}{1-\left(\dfrac{m}{m+1}\right)\left(\dfrac{1}{2m+1}\right)}$

$$=\frac{2m^2+m+m+1}{2m^2+2m+m+1-m}$$

$$=\frac{2m^2+2m+1}{2m^2+2m+1}=1$$

$$\therefore\quad \alpha+\beta=\frac{\pi}{4}.$$

**61.** **(b)** Given expression $=\dfrac{\cos 10°-\sqrt{3}\sin 10°}{\sin 10°\cos 10°}$

$$=\frac{\left[2\left(\frac{1}{2}\right)\cos 10°-\left(\frac{\sqrt{3}}{2}\right)\sin 10°\right]}{\left(\frac{1}{2}\right)\sin 20°}$$

$$=2(\sin 30°\cos 10°-\cos 30°\sin 10°)\times\frac{2}{\sin 20°}$$

$$=\frac{4\sin 20°}{\sin 20°}=4.$$

**62.** **(c)** Given expression $=\sqrt{2+\sqrt{2(2\cos^2 2A)}}$

$$=\sqrt{2+2\cos 2A}$$

$$=\sqrt{4\cos^2 A}=2\cos A.$$

**63.** **(a)** Given $\tan A=\dfrac{2\sin^2\left(\dfrac{B}{2}\right)}{2\sin\left(\dfrac{B}{2}\right)\cos\left(\dfrac{B}{2}\right)}$

$$=\tan\left(\frac{B}{2}\right)$$

$$\Rightarrow\quad A=\frac{B}{2}\quad\Rightarrow\quad 2A=B$$

$$\Rightarrow\quad \tan 2A=\tan B.$$

**64.** **(b)** Given expression $=\dfrac{\sin\left[\dfrac{\pi}{2}-2\theta\right]}{1-\cos\left(\dfrac{\pi}{2}-2\theta\right)}$

$$=\frac{2\sin\left(\frac{\pi}{4}-\theta\right)\cos\left(\frac{\pi}{4}-\theta\right)}{2\sin^2\left(\frac{\pi}{4}-\theta\right)}$$

$$=\cot\left(\frac{\pi}{4}-\theta\right).$$

**65.** **(a)** Given expression

$$=\frac{\tan 40°+\tan 20°}{1-\cot(90°-20°)\cot(90°-40°)}$$

$$=\frac{\tan 40°+\tan 20°}{1-\tan 20°\tan 40°}$$

$$=\tan(40°+20°)=\tan 60°=\sqrt{3}.$$

**66.** **(b)** Given expression

$$=\frac{\sqrt{3}}{\sin 20°}-\frac{1}{\cos 20°}=\frac{\sqrt{3}\cos 20°-\sin 20°}{\sin 20°\cos 20°}$$

$$=\frac{2\left[\left(\frac{\sqrt{3}}{2}\right)\cos 20°-\left(\frac{1}{2}\right)\sin 20°\right]}{\frac{1}{2}\sin 40°}$$

$$=\frac{2[\cos 30°\cos 20°-\sin 30°\sin 20°]}{\frac{1}{2}\sin 40°}$$

$$=\frac{4\cos 50°}{\sin 40°}=\frac{4\sin 40°}{\sin 40°}=4.$$

**67.** **(c)** Given expression

$$= (\tan 81° + \tan 9°) - (\tan 63° + \tan 27°)$$

$$= (\cot 9° + \tan 9°) - (\cot 27° + \tan 27°)$$

$$= \frac{1}{\sin 9° \cos 9°} = \frac{1}{\sin 27° \cos 27°}$$

$$= \frac{2}{\sin 18°} - \frac{2}{\sin 54°} = \frac{2(4)}{\sqrt{5}-1} - \frac{2(4)}{\sqrt{5}+1}$$

$$= \frac{8(\sqrt{5}+1-\sqrt{5}+1)}{4} = 4.$$

**68.** **(a)** We have, $5x = 3x + 2x$

$$\Rightarrow \quad \tan 5x = \frac{\tan 3x + \tan 2x}{1 - \tan 3x \tan 2x}$$

$$\Rightarrow \quad \tan 5x - \tan 5x \tan 3x \tan 2x = \tan 3x + \tan 2x$$

$$\Rightarrow \quad \tan 5x - \tan 3x - \tan 2x = \tan 5x \tan 3x \tan 2x.$$

**69.** **(b)** $\tan(A+B) = \dfrac{\dfrac{n}{n+1} + \dfrac{1}{2n+1}}{1 - \dfrac{n}{n+1} \times \dfrac{1}{2n+1}}$

$$= \frac{2n^2 + n + n + 1}{2n^2 + 2n + n + 1 - n}$$

$$= \frac{2n^2 + 2n + 1}{2n^2 + 2n + 1} = 1.$$

**70.** **(b)** $A$, $B$ are positive and each less than 90°

$$\therefore \quad \cos A = \frac{3}{\sqrt{10}}, \; \cos B = \frac{2}{\sqrt{5}}$$

$$\therefore \quad \sin(A+B) = \left(\frac{1}{\sqrt{10}}\right)\left(\frac{2}{\sqrt{5}}\right) + \left(\frac{3}{\sqrt{10}}\right)\left(\frac{1}{\sqrt{5}}\right)$$

$$= \frac{5}{\sqrt{50}} = \frac{5}{5\sqrt{2}} = \frac{1}{\sqrt{2}}$$

$$\therefore \quad A + B = \frac{\pi}{4}.$$

**71.** **(b)** Given expression

$$= \frac{\dfrac{2\sin^2\theta}{2} + \dfrac{2\sin\theta}{2}\dfrac{\cos\theta}{2}}{\dfrac{2\cos^2\theta}{2} + \dfrac{2\sin\theta}{2}\dfrac{\cos\theta}{2}}$$

$$= \frac{\dfrac{2\sin\theta}{2}\left[\dfrac{\sin\theta}{2} + \dfrac{\cos\theta}{2}\right]}{\dfrac{2\cos\theta}{2}\left[\dfrac{\sin\theta}{2} + \dfrac{\cos\theta}{2}\right]}$$

$$= \tan\frac{\theta}{2}.$$

**72.** **(a)** We have, $\tan A = \dfrac{1 - \cos 2A}{\sin 2A}$. Put $A = 7\dfrac{1}{2}°$

$$\tan 7\frac{1}{2}° = \frac{1 - \cos 15°}{\sin 15°} = \frac{1 - \dfrac{\sqrt{3}+1}{2\sqrt{2}}}{\dfrac{\sqrt{3}-1}{2\sqrt{2}}}$$

$$= \frac{2\sqrt{2} - (\sqrt{3}+1)}{\sqrt{3}-1}.$$

**73.** **(a)** $\dfrac{4\cos^3 A - 3\cos A + 3\sin A - 4\sin^3 A}{\cos A - \sin A}$

$= 1 - K \sin 2A$

$\Rightarrow \quad 1 + 2 \sin 2A = 1 - K \sin 2A$

$\Rightarrow \quad K = -2.$

**74.** **(b)** $\tan 45° = \tan(57° - 12°)$

$$1 = \frac{\tan 57° - \tan 12°}{1 + \tan 57° \tan 12°}$$

$\Rightarrow \quad \tan 57° - \tan 12° = 1 + \tan 57° \tan 12°$

$\Rightarrow \quad \tan 57° - \tan 12° - \tan 57° \tan 12° = 1.$

**75.** **(a)** Given expression

$$= \sqrt{4\sin^4\theta + 4\sin^2\theta\cos^2\theta} + 2\left[1 + \cos\left(\frac{\pi}{2} - \theta\right)\right]$$

$$= \sqrt{4\sin^2\theta(\sin^2\theta + \cos^2\theta)} + 2(1 + \sin\theta)$$

$= 2|\sin\theta| + 2 + 2\sin\theta$

$= -2\sin\theta + 2 + 2\sin\theta$

$= 2$(since $180° < \theta < 270° \quad \Rightarrow \quad |\sin\theta| = -\sin\theta$)

**76.** **(d)** $\tan 225° = \tan(100° + 125°)$

$$1 = \frac{\tan 100° + \tan 125°}{1 - \tan 100° \tan 125°}$$

$\Rightarrow \quad \tan 100° + \tan 125° + \tan 100° \tan 125° = 1.$

**77.** **(d)** Given expression

$$= \sqrt{\frac{(1+\sin\theta)^2}{(1+\sin\theta)(1-\sin\theta)}} = \frac{1+\sin\theta}{\cos\theta}$$

$= \sec\theta + \tan\theta.$

**78.** **(b)** $\tan\theta = \dfrac{1 + \tan 15°}{1 - \tan 15°} = \dfrac{\tan 45° + \tan 15°}{1 - \tan 45° \tan 15°}$

$= \tan(45° + 15°)$

$= \tan 60° = \tan\dfrac{\pi}{3}$

$\therefore \quad \theta = \dfrac{\pi}{3}.$

**79. (c)** $\tan 45° = \tan(56° - 11°)$

$1 = \dfrac{\tan 56° - \tan 11°}{1 + \tan 56° \tan 11°}$

$1 + \tan 56° \tan 11° = \tan 56° - \tan 11°$

$\therefore \quad \tan 56° - \tan 11° - \tan 56° \tan 11° = 1.$

**80. (c)** $\cot(A + B) = \cot 45°$

$\Rightarrow \quad \dfrac{\cot A \cot B - 1}{\cot B + \cot A} = 1$

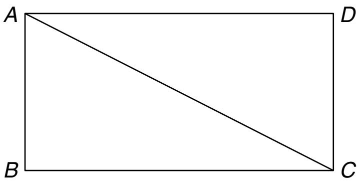
$\Rightarrow \quad \cot A \cot B - \cot A - \cot B + 1 = 1 + 1$

$\Rightarrow \quad (\cot A - 1)(\cot B - 1) = 2$

$\Rightarrow \quad K = \dfrac{1}{2}.$

## EXERCISE-2
## (BASED ON MEMORY)

**1. (c)**




$\angle ACD = 45°$

$\angle BAC = 45°$

$\therefore \quad (\tan^2 \angle CAD + 1) \cdot \sin^2 \angle BAC$

$= (\tan^2 45° + 1) \sin^2 45°$

$= (1+1) \times \left(\dfrac{1}{\sqrt{2}}\right)^2 = 2 \times \dfrac{1}{2} = 1$

**2. (b)** $\tan x = \sin 45° \cdot \cos 45° + \sin 30°$

$= \dfrac{1}{\sqrt{2}} \cdot \dfrac{1}{\sqrt{2}} + \dfrac{1}{2} = \dfrac{1}{2} + \dfrac{1}{2} = 1$

$\therefore \quad \tan x = \tan 45° \quad \Rightarrow \quad x = 45°$

**3. (c)** $\sqrt{\dfrac{\sec\theta - 1}{\sec\theta + 1}} = \sqrt{\dfrac{\dfrac{1}{\cos\theta} - 1}{\dfrac{1}{\cos\theta} + 1}} = \sqrt{\dfrac{\dfrac{1-\cos\theta}{\cos\theta}}{\dfrac{1+\cos\theta}{\cos\theta}}}$

$= \sqrt{\dfrac{1-\cos\theta}{1+\cos\theta}} = \sqrt{\dfrac{(1-\cos\theta)(1-\cos\theta)}{(1+\cos\theta)(1-\cos\theta)}}$

(Rationalising the numerator and the denominator)

$= \sqrt{\dfrac{(1-\cos\theta)^2}{1-\cos^2\theta}} = \sqrt{\dfrac{(1-\cos\theta)}{\sin^2\theta}}$

$= \dfrac{1-\cos\theta}{\sin\theta} = \dfrac{1}{\sin\theta} - \dfrac{\cos\theta}{\sin\theta} = \operatorname{cosec}\theta - \cot\theta.$

**4. (b)** Let, the angles be $A$ and $B$ where $A>B$.

$\therefore \quad A + B = 135°$ and $A - B = \dfrac{\pi}{12} = \dfrac{\pi}{12} \times \dfrac{180°}{\pi} = 15°$

On adding both, we have,

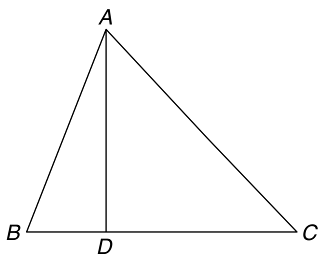
$A + B + A - B = 135° + 15° = 150°$

$\Rightarrow \quad 2A = 150° \quad \Rightarrow \quad A = \dfrac{150}{2} = 75°$

$\therefore \quad A + B = 135°$

$\Rightarrow \quad B = 135° - 75° = 60°$

**5. (c)**




$\angle B = \dfrac{\pi}{3}, \angle C = \dfrac{\pi}{3}$ and $\dfrac{BD}{DC} = \dfrac{1}{3}$

From $ABD$, we have,

$\dfrac{BD}{\sin \angle BAD} = \dfrac{AD}{\sin \angle ABD}$

$\Rightarrow \quad \dfrac{BD}{\sin \angle BAD} = \dfrac{AD}{\sin\dfrac{\pi}{3}}$

$\Rightarrow \quad \dfrac{BD}{\sin \angle BAD} = \dfrac{AD}{\dfrac{\sqrt{3}}{2}}$

$$\Rightarrow \quad AD = \frac{\sqrt{3}}{2} \cdot \frac{BD}{\sin \angle BAD} \qquad \ldots(1)$$

From $ADC$, we have,

$$\frac{CD}{\sin \angle DAC} = \frac{AD}{\sin \angle ACD}$$

$$\Rightarrow \quad \frac{CD}{\sin \angle DAC} = \frac{AD}{\sin \frac{\pi}{4}}$$

$$\Rightarrow \quad AD = \frac{1}{\sqrt{2}} \cdot \frac{CD}{\sin \angle DAC} \qquad \ldots(2)$$

From equations (1) and (2), we have,

$$\frac{\sqrt{3}}{2} \cdot \frac{BD}{\sin \angle BAD} = \frac{1}{\sqrt{2}} \cdot \frac{CD}{\sin \angle DAC}$$

$$\Rightarrow \quad \frac{\sin \angle BAD}{\sin \angle DAC} = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{\sqrt{2}}} \times \frac{BD}{CD}$$

$$\Rightarrow \quad \frac{\sin \angle BAD}{\sin \angle DAC} = \frac{\sqrt{3}}{2} \times \sqrt{2} \times \frac{1}{3}$$

$$= \frac{1}{\sqrt{2} \times \sqrt{3}} = \frac{1}{\sqrt{6}}$$

**6.** **(a)** sin $3A$ = cos ($A$ – 26°)

$$\Rightarrow \quad \cos(90° - 3A) = \cos(A - 26°)$$

$$\Rightarrow \quad 90° - 3A = A - 26°$$

$$\Rightarrow \quad 90° + 26° = 3A + A$$

$$\Rightarrow \quad 4A = 116°$$

$$\Rightarrow \quad A = \frac{116°}{4} = 29°$$

**7.** **(a)** $\sec^2 \theta - \dfrac{\sin^2 \theta - 2\sin^4 \theta}{2\cos^4 \theta - \cos^2 \theta}$

$$= \sec^2 \theta - \frac{\sin^2 \theta (1 - 2\sin^2 \theta)}{\cos^2 \theta (2\cos^2 \theta - 1)}$$

$$= \sec^2 \theta - \frac{\sin^2 \theta [1 - 2(1 - \cos^2 \theta)]}{\cos^2 \theta (2\cos^2 \theta - 1)}$$

$$= \sec^2 \theta - \tan^2 \theta \frac{(2\cos^2 \theta - 1)}{2\cos^2 \theta - 1}$$

$$= \sec^2 \theta - \tan^2 \theta = 1$$

**8.** **(c)** $x = a(\sin\theta + \cos\theta)$ and $y = b(\sin\theta - \cos\theta)$

$$= \frac{x}{a} = \sin \theta + \cos \theta \text{ and } \frac{y}{b} = \sin \theta - \cos \theta$$

$$\therefore \quad \frac{x^2}{a^2} + \frac{y^2}{b^2} = (\sin \theta + \cos \theta)^2 + (\sin \theta - \cos \theta)^2$$

$$= \sin^2 \theta + \cos^2 \theta + 2 \sin \theta \cdot \cos \theta + \sin^2 \theta$$

$$+ \cos^2 \theta - 2 \sin \theta \cdot \cos \theta$$

$$= 2(\sin^2 \theta + \cos^2 \theta) = 2$$

**9.** **(d)** sin $5\theta$ = cos 20°

$$\Rightarrow \quad \sin 5\theta = \sin(90° - 20°) = \sin 70°$$

$$\Rightarrow \quad 5\theta = 70°$$

$$\Rightarrow \quad \theta = \frac{70°}{5} = 14°$$

**10.** **(d)** $\sin \theta + \cos \theta = \sqrt{2} \cos \theta \qquad \ldots(1)$

$\cos \theta - \sin \theta = x \qquad \ldots(2)$

On squaring and adding both the equations, we get,

$\sin^{2\theta} + \cos^{2\theta} + 2 \sin\theta.\cos\theta + \cos^{2\theta} + \sin^{2\theta} - 2 \sin\theta.\cos\theta = 2\cos^{2\theta} + x^2$

$$\Rightarrow \quad 2 = 2\cos^2 \theta + x^2$$

$$\Rightarrow \quad x^2 = 2(1 - \cos^2 \theta) = 2\sin^2 \theta$$

$$\Rightarrow \quad x = \sqrt{2} \sin \theta$$

**11.** **(a)** $x$ sin 45° = $y$ cosec 30°

$$\Rightarrow \quad x \times \frac{1}{\sqrt{2}} = y \times 2$$

$$\Rightarrow \quad \frac{x}{y} = 2\sqrt{2}$$

$$\Rightarrow \quad \frac{x^4}{y^4} = (2\sqrt{2})^4 = 2^4 \times 2^2 = 2^6 = 4^3$$

**12.** **(a)** $\tan\theta + \cot\theta = 2$

$$\Rightarrow \quad \tan \theta + \frac{1}{\tan \theta} = 2 \quad \Leftrightarrow \quad \tan^2 \theta + 1 = 2 \tan \theta$$

$$\Rightarrow \quad \tan^2 \theta - 2 \tan \theta + 1 = 0$$

$$\Rightarrow \quad (\tan \theta - 1)^2 = 0 \quad \Leftrightarrow \quad \tan \theta = 1$$

$$\therefore \quad \cot \theta = \frac{1}{\tan \theta} = 1$$

$$\therefore \quad \tan^{100} \theta + \cot^{100} \theta = 1 + 1 = 2$$

**13.** **(d)** The given expression $= \dfrac{\tan \theta}{1 - \cot \theta} + \dfrac{\cot \theta}{1 - \tan \theta}$

$$= \frac{\tan \theta}{1 - \frac{1}{\tan \theta}} + \frac{\frac{1}{\tan \theta}}{1 - \tan \theta} = \frac{\tan^2 \theta}{\tan \theta - 1} + \frac{1}{\tan \theta (1 - \tan \theta)}$$

$$= \frac{\tan^2\theta}{\tan\theta - 1} - \frac{1}{\tan\theta(\tan\theta - 1)}$$

$$= \frac{\tan^3\theta - 1}{\tan\theta(\tan\theta - 1)} = \frac{(\tan\theta - 1)(\tan^2\theta + \tan\theta + 1)}{\tan\theta(\tan\theta - 1)}$$

$$= \frac{\tan^2\theta + \tan\theta + 1}{\tan\theta} = \tan\theta + \cot\theta + 1$$

**14. (b)** $\sec\theta = x + \frac{1}{4x} = \frac{4x^2 + 1}{4x}$

$\because \tan\theta = \sqrt{\sec^2\theta - 1}$

$$= \sqrt{\left(\frac{4x^2 + 1}{4x}\right)^2 - 1} = \sqrt{\frac{(4x^2 + 1)^2 - (4x)^2}{(4x)^2}}$$

$$= \sqrt{\frac{(4x^2 + 1 - 4x)(4x^2 + 1 + 4x)}{(4x)^2}}$$

$$= \sqrt{\frac{[(2x)^2 + (1)^2 - 2 \times 1 \times 2x][(2x)^2 + (1)^2 - 2 \times 1 \times 2x]}{(4x)^2}}$$

$$= \sqrt{\frac{(2x - 1)^2(2x + 1)^2}{(4x)^2}}$$

$$= \frac{(2x + 1)(2x - 1)}{4x} = \frac{4x^2 - 1}{4x}$$

$$\therefore \sec\theta + \tan\theta = \frac{4x^2 + 1}{4x} + \frac{4x^2 - 1}{4x}$$

$$= \frac{4x^2 + 1 + 4x^2 - 1}{4x} = \frac{8x^2}{4x} = 2x$$

**15. (c)** Sum of remaining two angles $= \pi - \frac{5\pi}{9} = \frac{4\pi}{9}$

$\therefore$ Each angle $= \frac{1}{2} \times \frac{4\pi}{9} = \frac{2\pi}{9}$

**16. (a)** $x = r\cos\theta \cdot \cos\phi$

$y = r\cos\theta \cdot \sin\phi$

$z = r\sin\theta$

$$\therefore x^2 + y^2 + z^2 = r^2\cos^2\theta \cdot \cos^2\phi + r^2\cos^2\theta \cdot \sin^2\phi + r^2\sin^2\theta$$

$$= r^2\cos^2\theta(\cos^2\phi + \sin^2\phi) + r^2\sin^2\theta$$

$$= r^2\cos^2\theta + r^2\sin^2\theta$$

$$= r^2(\cos^2\theta + \sin^2\theta) = r^2$$

**17. (c)** $5 \cos \theta + 12 \sin \theta = 13$

Dividing by $\cos \theta$, we get

$5 + 12 \tan \theta = 13 \sec \theta$

On squaring, we have

$25 + 144 \tan^2\theta + 120 \tan \theta = 169 \sec^2\theta = 169 (1 + \tan^2\theta)$

$\Rightarrow \quad 169 \tan^2\theta - 144 \tan^2\theta - 120 \tan \theta = 169 - 25$

$\Rightarrow \quad 25 \tan^2\theta - 120 \tan\theta + 144 = 0$

$\Rightarrow \quad (5 \tan\theta - 12)^2 = 0$

$\Rightarrow \quad 5\tan\theta = 12$

$\Rightarrow \quad \tan\theta = \frac{12}{5}$

**18. (b)** $\sec^2 12° - \cot^2 78°$

$= \sec^2 12° - \cot^2 (90° - 12°)$

$= \sec^2 12° - \tan^2 12° = 1$

$[\because \sec^2\theta - \tan^2\theta = 1]$

**19. (d)** $\tan\theta \cdot \cos 60° = \frac{\sqrt{3}}{2}$

$\Rightarrow \quad \tan\theta \times \frac{1}{2} = \frac{\sqrt{3}}{2}$

$\Rightarrow \quad \tan\theta = \sqrt{3} = \tan 60°$

$\Rightarrow \quad \theta = 60°$

$\therefore \sin(\theta - 15°) = \sin(60° - 15°) = \sin 45° = \frac{1}{\sqrt{2}}$

**20. (c)** $\tan 2\theta \cdot \tan 3\theta = 1$

$\Rightarrow \quad \tan 3\theta = \frac{1}{\tan 2\theta} = \cot 2\theta$

$\Rightarrow \quad \tan 3\theta = \tan(90° - 2\theta)$

$\Rightarrow \quad 3\theta = 90° - 2\theta \Rightarrow 5\theta = 90° \Rightarrow \theta = 18°$

$\therefore \quad 2\cos^2\frac{5\theta}{2} - 1 = 2\cos^2 45° - 1 = 2 \times \frac{1}{2} - 1 = 0$

**21. (b)** $\sin 17° = \frac{x}{y}$

$\Rightarrow \quad \cos 17° = \sqrt{1 - \sin^2 17°}$

$$= \sqrt{1 - \frac{x^2}{y^2}} = \sqrt{\frac{y^2 - x^2}{y^2}} = \frac{\sqrt{y^2 - x^2}}{y}$$

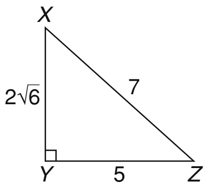
$\therefore\ \sec 17° = \dfrac{y}{\sqrt{y^2 - x^2}}$

$\sin 73° = \sin(90° - 17°) = \cos\ 17°$

$\therefore\ \sec 17° - \sin 73° = \dfrac{y}{\sqrt{y^2 - x^2}} - \dfrac{\sqrt{y^2 - x^2}}{y}$

$= \dfrac{y^2 - y^2 + x^2}{y\sqrt{y^2 - x^2}} = \dfrac{x^2}{y\sqrt{y^2 - x^2}}$

**22. (b)**




$XZ - YZ = 2$

$\Rightarrow\ XY^2 + YZ^2 = XZ^2$

$\Rightarrow\ \left(2\sqrt{6}\right)^2 = XZ^2 - YZ^2$

$\Rightarrow\ 24 = (XZ - YZ)(XZ + YZ)$

$\Rightarrow\ XZ + YZ = 12$

Adding both the equations, we have

$2XZ = 14 \Rightarrow XZ = 7 \qquad \therefore\ YZ = 7 - 2 = 5$

$\sec X = \dfrac{7}{2\sqrt{6}}$

$\tan X = \dfrac{5}{2\sqrt{6}}$

$\therefore\ \sec X + \tan X = \dfrac{7}{2\sqrt{6}} + \dfrac{5}{2\sqrt{6}} = \dfrac{12}{2\sqrt{6}} = \sqrt{6}$

**23. (b)** $Z = \sin\theta + \cos\theta$

$\Rightarrow Z^2 = \sin^2\theta + \cos^2\theta + 2\sin\theta\cdot\cos\theta$

$= 1 + 2\sin\theta\cdot\cos\theta$

Now, $\because\ 0 < \theta < 90° \qquad \therefore\ \sin\theta < 1; \cos\theta < 1$

$\Rightarrow\ 2\sin\theta\cdot\cos\theta < 1$

$\therefore\ Z^2 < 2 \qquad \Rightarrow\ Z < \sqrt{2} \quad \Rightarrow\ Z < 1.41$

Clearly, the value of $\sin\theta + \cos\theta$ is greater than 1.

**24. (b)** $\dfrac{\tan 57° + \cot 37°}{\tan 33° + \cot 53°} = \dfrac{\cot 33° + \tan 53°}{\tan 33° + \cot 53°}$

$[\because\ \tan(90° - \theta) = \cot\theta, \cot(90° - \theta) = \tan\theta]$

$= \dfrac{\dfrac{1}{\tan 33°} + \tan 53°}{\tan 33° + \dfrac{1}{\tan 53°}}$

$= \dfrac{1 + \tan 53°\cdot\tan 33°}{\tan 33°\cdot\tan 53° + 1} \times \dfrac{\tan 53°}{\tan 33°}$

$= \tan 53°\cdot\cot 33° = \cot 37°\cdot\tan 57°$

**25. (d)** $\sin^2\theta + \cos^2\theta + \sec^2\theta + \mathrm{cosec}^2\theta + \tan^2\theta + \cot^2\theta$

$= 1 + \sec^2\theta - \tan^2\theta + \mathrm{cosec}^2\theta - \cot^2\theta + 2(\tan^2\theta + \cot^2\theta)$

$= 3 + 2((\tan\theta - \cot\theta)^2 + 2) > 7$; because $(\tan\theta - \cot\theta)^2 > 0$

**26. (d)** $x^2 + \dfrac{1}{x^2} = 2\sin\left(\dfrac{\pi}{2}\right)$

**27. (c)**

$\because\ \sin^2\alpha + \sin^2\beta = 2$

$\Rightarrow\ 1 - \cos^2\alpha + 1 - \cos^2\beta = 2$

$\Rightarrow\ \cos^2\alpha + \cos^2\beta = 0$

$\Rightarrow\ \cos\alpha = 0$ and $\cos\beta = 0$

$\Rightarrow\ \alpha = \dfrac{\pi}{2}$ and $\beta = \dfrac{\pi}{2}$

$\therefore\ \cos\left(\dfrac{\alpha + \beta}{2}\right) = \cos\left(\dfrac{\dfrac{\pi}{2} + \dfrac{\pi}{2}}{2}\right) = \cos\left(\dfrac{\pi}{2}\right) = 0$

**28. (d)** $\cot\dfrac{\pi}{20}\cdot\cot\dfrac{3\pi}{20}\cdot\cot\dfrac{5\pi}{20}\cdot\cot\dfrac{7\pi}{20}\cdot\cot\dfrac{9\pi}{20}$

$= \cot 9°\cdot\cot 27°\cdot\cot 45°\cdot\cot 63°\cdot\cot 81° [\because\ \pi = 180°]$

$= \cot 9°\cdot\cot 27°\cdot\cot 45°\cdot\cot(90° - 27°)\cdot\cot(90° - 9°)$

$= \cot 9°\cdot\cot 27°\cdot\cot 45°\cdot\tan 27°\cdot\tan 9°$

$[\cot(90° - \theta) = \tan\theta]$

$= (\cot 9°\cdot\tan 9°)\cdot(\cot 27°\cdot\tan 27°)\cdot\cot 45° = 1$

$[\because\ \tan\theta\cdot\cot\theta = 1]$

**29. (d)** $\sin\theta + \cos\theta = \dfrac{17}{23}$ …(1)

Let, $\sin\theta - \cos\theta = x$ …(2)

On squaring and adding both the equations, we have

$$\sin^2\theta + \cos^2\theta + 2\sin\theta\cdot\cos\theta + \sin^2\theta + \cos^2\theta$$

$$-2\sin\theta\cdot\cos\theta = \left(\frac{17}{13}\right)^2 + x^2$$

$$\Rightarrow \quad 2(\sin^2\theta + \cos^2\theta) = \frac{289}{169} + x^2$$

$$\Rightarrow \quad x^2 = 2 - \frac{289}{169} = \frac{338-289}{169} = \frac{49}{169}$$

$$\Rightarrow \quad x = \sqrt{\frac{49}{169}} = \frac{7}{13}$$

**30. (c)** $\tan\theta\cdot\tan 2\theta = 1$

$$\Rightarrow \quad \tan\theta = \frac{1}{\tan 2\theta} = \cot 2\theta$$

$$\Rightarrow \quad \tan\theta = \tan(90° - 20)$$

$$\Rightarrow \quad \theta = 90° - 2\theta$$

$$\Rightarrow \quad 3\theta = 90° \Rightarrow \theta = 30°$$

$$\therefore \quad \sin^2 2\theta + \tan^2 2\theta = \sin^2 60° + \tan^2 60°$$

$$= \left(\frac{\sqrt{3}}{2}\right)^2 + \left(\sqrt{3}\right)^2 = \frac{3}{4} + 3 = 3\frac{3}{4}$$

# Heights and Distance

# 36

## INTRODUCTION

Solution of triangles has enormous applications to surveying, navigation, and so on. We shall now consider some simple ones from among them. For this purpose, we need to explain certain terms that are generally used in practical problems.

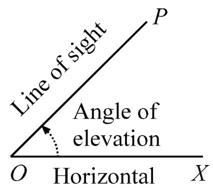



**Fig. (a)**

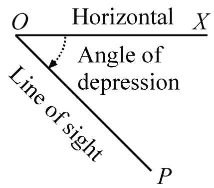



**Fig. (b)**

1. If $OX$ be a horizontal line through $O$, the eye of the observer and $P$ be an object in the vertical plane through $OX$, then $\angle XOP$ is called:

   (i) **the angle of elevation,** if $P$ is *above* $OX$ as shown in Fig. (a); and
   (ii) the **angle of depression,** if $P$ is *below* $OX$ as shown in Fig. (b).

   The straight line $OP$ (joining the eye of the observer to the object) is called the *line of sight* of the observer.

2. Values of the trigonometric ratios for some useful angles:

The values of cot$\theta$, sec$\theta$ and cosec$\theta$ can be found from Table 1, by using the relations $\cot\theta = \frac{\cos\theta}{\sin\theta}$, $\sec\theta = \frac{1}{\cos\theta}$ and $\text{cosec}\,\theta = \frac{1}{\sin\theta}$.

**Table 1**

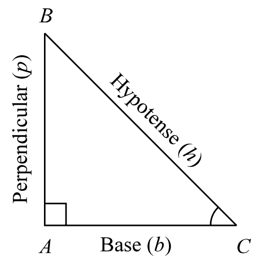
| angle ($\theta$) / $t$-ratio | 0° | 30° | 45° | 60° | 90° |
|---|---|---|---|---|---|
| $\sin\theta$ | 0 | $\frac{1}{2}$ | $\frac{1}{\sqrt{2}}$ | $\frac{\sqrt{3}}{2}$ | 1 |
| $\cos\theta$ | 1 | $\frac{\sqrt{3}}{2}$ | $\frac{1}{\sqrt{2}}$ | $\frac{1}{2}$ | 0 |
| $\tan\theta$ | 0 | $\frac{1}{\sqrt{3}}$ | 1 | $\sqrt{3}$ | Undefined |

3. **Pythagoras Theorem**

In a right-angled triangle, the square of its hypoteuse is equal to the sum of the squares of its legs (i.e., perpendicular and base).

In other words,

$(\text{Hypotenuse})^2 = (\text{Perpendicular})^2 + (\text{Base})^2$




or, $(BC)^2 = (AB)^2 + (AC)^2$ or, $h^2 = p^2 + b^2$.

4. Few important values to memorise:

$$\sqrt{2} = 1.414;\ \sqrt{3} = 1.732;\ \sqrt{5} = 2.236.$$

## EXERCISE-1

1. The ratio of the length of a rod and its shadow is $1 : \sqrt{3}$.

   The angle of elevation of the sum is:

   (a) 30° (b) 45°
   (c) 60° (d) 90°

2. The angle of elevation of moon when the length of the shadow of a pole is equal to its height, is:

(a) 30° (b) 45°
(c) 60° (d) None of these

**3.** A tower stands on a horizontal plane. A man on the ground 100 m from the base of the tower finds the angle of elevation of the top of the tower to be 30°. What is the height of the tower?

(a) 100 m (b) $100\sqrt{3}$
(c) $100/\sqrt{3}$ (d) None of these

**4.** When the sun is 30° above the horizontal, the length of shadow cast by a building 50 m high is:

(a) $\frac{50}{\sqrt{3}}$ m (b) $50\sqrt{3}$ m
(c) 25 m (d) $25\sqrt{3}$ m

**5.** A pole being broken by the wind, the top struck the ground at an angle of 30° and at a distance of 21 m from the foot of the pole. Find out the total height of the pole.

(a) 21 m (b) $21\sqrt{3}$ m
(c) $21/\sqrt{3}$ (d) None of these

**6.** The upper part of a tree broken by the wind makes an angle of 30° with the ground and the distance from the root to the point where the top of the tree touches the ground is 10 m. What was the height of the tree?

(a) $10\sqrt{3}$ (b) $10/\sqrt{3}$
(c) $20\sqrt{3}$ (d) None of these

**7.** A tower stands at the end of a straight road. The angles of elevation of the top of the tower from two points on the road 500 m apart are 45° and 60°, respectively. Find out the height of the tower.

(a) $\frac{500\sqrt{3}}{\sqrt{3}-1}$ (b) $5000\sqrt{3}$

(c) $\frac{500\sqrt{3}}{\sqrt{3}+1}$ (d) None of these

**8.** The shadow of a tower standing on a level plane is found to be 50 m longer when the sun's altitude is 30° than when it is 60°. Find the height of the tower.

(a) $20\sqrt{3}$ m (b) $25/\sqrt{3}$ m
(c) $25\sqrt{3}$ m (d) $20\sqrt{3}$ m

**9.** In a rectangle, if the angle between a diagonal and a side is 30° and the length of diagonal is 6 cm, the area of the rectangle is:

(a) 9 $cm^2$ (b) $9\sqrt{3}$ $cm^2$
(c) 27 $cm^2$ (d) 36 $cm^2$

**10.** The height of a tower is 100 m. When the angle of elevation of the sun changes from 30° to 45°, the shadow of the tower becomes $x$ m smaller. The value of $x$ is:

(a) 100 m (b) $100\sqrt{3}$ m
(c) $100(\sqrt{3} - 1)$ m (d) $\frac{100}{\sqrt{3}}$ m

**11.** A 20 m high electric pole stands upright on the ground with the help of steel wire to its top and affixed on the ground. If the steel wire makes 60° with the horizontal ground, then find out the length of the steel wire.

(a) $40/\sqrt{3}$ m (b) $40\sqrt{3}$ m
(c) $20/\sqrt{3}$ m (d) $20\sqrt{3}$ m

**12.** From the top of a lighthouse, 50 m above the sea, the angle of depression of an incoming boat is 30°. How far is the boat from the lighthouse?

(a) $25\sqrt{3}$ m (b) $25/\sqrt{3}$ m
(c) $50\sqrt{3}$ m (d) $50/\sqrt{3}$ m

**13.** From the top of a 25 m high, cliff the angle of elevation of a tower is found to be equal to the angle of depression of the foot of the tower. Find out the height of the tower.

(a) 40 m (b) 48 m
(c) 50 m (d) 52 m

**14.** When the length of the shadow of a pole is equal to the height of the pole, then the elevation of source of light is:

(a) 30° (b) 45°
(c) 60° (d) 75°

**15.** From the top of 60 m high a lighthouse with its base at sea level, the angle of depression of a boat is 15°. The distance of the boat from the light house is:

(a) $60\left(\frac{\sqrt{3}-1}{\sqrt{3}+1}\right)$ m (b) $60\left(\frac{\sqrt{3}+1}{\sqrt{3}-1}\right)$ m

(c) $30\left(\frac{\sqrt{3}-1}{\sqrt{3}+1}\right)$ m (d) $30\left(\frac{\sqrt{3}+1}{\sqrt{3}-1}\right)$ m

**16.** On the level ground, the angle of elevation of the top of the tower is 30°. On moving 20 m nearer, the angle of elevation is 60°. The height of the tower is:

(a) $20\sqrt{3}$ m (b) $10\sqrt{3}$ m
(c) $10(\sqrt{3} - 1)$ m (d) None of these

**17.** The angle of elevation of the top of a tower from a point 20 m away from its base is 45°. The height of the tower is:

(a) 10 m (b) 20 m
(c) 40 m (d) $20\sqrt{3}$ m

**18.** At a point, 15 m away from the base of a 15 m high house, the angle of elevation of the top is:

(a) 45° (b) 30°
(c) 60° (d) 90°

**19.** Angle of depression from the top of a lighthouse of two boats are 45° and 30° due east which are 60 m apart. The height of the light house is:

(a) $60\sqrt{3}$ (b) $30(\sqrt{3}-1)$
(c) $30(\sqrt{3}+1)$ (d) None of these

**20.** The angle of elevation of the top of a hill from each of the vertices $A$, $B$, $C$ of a horizontal triangle is $\alpha$. The height of the hill is:

(a) $b \tan \alpha \operatorname{cosec} B$ (b) $\frac{a}{2} \tan \alpha \operatorname{cosec} A$
(c) $\frac{c}{2} \tan \alpha \operatorname{cosec} C$ (d) None of these

**21.** A tower subtends an angle of 30° at a point on the same level as the foot of the tower. At a second point, $h$ m above the first, the depression of the foot of the tower is 60°. The horizontal distance of the tower from the point is:

(a) $h \cot 60°$ (b) $h \cot 30°$
(c) $\frac{h}{2} \cot 60°$ (d) $\frac{h}{2} \cot 30°$

**22.** If a flag staff of 6 m height placed on the top of a tower throws a shadow of $2\sqrt{3}$ m along the ground, then the angle that the sun makes with the ground is:

(a) 60° (b) 30°
(c) 45° (d) None of these

**23.** A person standing on the bank of a river observes that the angle subtended by a tree on the opposite bank is 60°. When he retires 40 m from the bank, he finds the angle to be 30°. The breadth of the river is:

(a) 40 m (b) 60 m
(c) 20 m (d) 30 m

**24.** The angle of elevation of the sun when the length of the shadow of a pole is $\sqrt{3}$ times the height of the pole will be:

(a) 30° (b) 60°
(c) 90° (d) 45°

**25.** The angle of elevation of the top of a TV tower from three points $A$, $B$, $C$ in a straight line through the foot of the tower are $\alpha$, $2\alpha$, $3\alpha$, respectively. If $AB = a$, the height of the tower is:

(a) $a \tan \alpha$ (b) $a \sin \alpha$
(c) $a \sin 2\alpha$ (d) $a \sin 3\alpha$

**26.** The angle of elevation of the top of an unfinished tower at a point distant 120 m from its base is 45°. If the elevation of the top at the same point is to be 60°, the tower must be raised to a height:

(a) $120(\sqrt{3}+1)$ m (b) $120(\sqrt{3}-1)$ m
(c) $10(\sqrt{3}+1)$ m (d) None of these

**27.** A person walking along a straight road towards a hill observes at two points, distance $\sqrt{3}$ Km, the angles of elevation of the hill to be 30° and 60°. The height of the hill is:

(a) $\frac{3}{2}$ Km (b) $\sqrt{\frac{2}{3}}$ Km
(c) $\frac{\sqrt{3}+1}{2}$ Km (d) $\sqrt{3}$ Km

**28.** The tops of two poles of height 20 m and 14 m are connected by a wire. If the wire makes an angle 30° with the horizontal, then the length of the wire is:

(a) 12 m (b) 10 m
(c) 8 m (d) None of these

**29.** A man is standing on the 8 m long shadow of a 6 m long pole. If the length of the shadow is 2.4 m, then the height of the man is:

(a) 1.4 m (b) 1.6 m
(c) 1.8 m (d) 2.0 m.

**30.** The angle of elevation of the top of a tower at a point $G$ on the ground is 30°. On walking 20 m towards the tower, the angle of elevation becomes 60°. The height of the tower is equal to:

(a) $\frac{10}{\sqrt{3}}$ m (b) $20\sqrt{3}$ m
(c) $\frac{20}{\sqrt{3}}$ m (d) $10\sqrt{3}$ m

## EXERCISE-2
## (BASED ON MEMORY)

1. The top of a 15 m high tower makes an angle of elevation of 60° with the bottom of an electric pole and an angle of elevation of 30° with the top of the pole. What is the height of the electric pole?

(a) 5 m (b) 8 m
(c) 10 m (d) 12 m
(e) None of these

**[SBI PO Examination, 1999]**

2. A man is watching from the top of a tower a boat speeding away from the tower. The boat makes an angle of depression of 45° with the man's eye when at a distance of 60 m from the tower. After 5 second, the angle of depression becomes 30°. What is the approximate speed of the boat, assuming it is running in still water?

(a) 32 Km/h (b) 42 Km/h
(c) 38 Km/h (d) 36 Km/h
(e) 40 Km/h

**[SBI Associates PO Examination, 1999]**

3. From a point $P$ on a level ground, the angle of elevation of the top of the tower is 30°. If the tower is 100 m high, the distance of the point $P$ from the foot of the tower is:

(a) $100/\sqrt{3}$ m (b) $100\sqrt{3}$ m
(c) $50\sqrt{3}$ m (d) $50/\sqrt{3}$ m

**[RRB Gorakhpur ASM Examination, 2002]**

4. From a 15 m high bridge on the river, the angle of depression of a boat is 30°. If the speed of the boat be 6 Km/h, then the time taken by the boat to reach exactly below the bridge will be:

(a) $9\sqrt{3}$ second (b) $19/\sqrt{3}$ second
(c) $3\sqrt{3}$ second (d) None of these

**[RRB Gorakhpur ASM Examination, 2002]**

5. From the top of a tower of height 108 m the angles of depression of two objects on either sides of the tower are 30° and 45°. The distance between the objects are:

(a) $180(3+\sqrt{3})$ m (b) $180(3-\sqrt{3})$ m
c) $180(\sqrt{3}-1)$ m (d) $180(\sqrt{3}+1)$ m

**[SSC, 2014]**

6. A tower standing on a horizontal plane subtends a certain angle at a point 160 m apart from the foot of the tower. On advancing 100 m towards it, the tower is found to subtend an angle twice as before. The height of the tower is:

(a) 80 m (b) 100 m
(c) 160 m (d) 200 m

**[SSC, 2013]**

7. The angle of elevation of a tower from a distance 50 m from its foot is 30°. The height of the tower is:

(a) $50\sqrt{3}$ m (b) $\frac{50}{\sqrt{3}}$ m
(c) $75\sqrt{3}$ m (d) $\frac{75}{\sqrt{3}}$ m

**[SSC, 2013]**

8. *ABCD* is a rectangle where the ratio of the lengths of *AB* and *BC* is 3:2. If *P* is the midpoint of *AB*, then the value of sin ($\angle CPB$) is:

(a) $\frac{3}{5}$ (b) $\frac{2}{5}$
(c) $\frac{3}{4}$ (d) $\frac{4}{5}$

**[SSC, 2013]**

9. $\frac{\sin A}{1+\cos A}+\frac{\sin A}{1-\cos A}$ is $(0° < A < 90°)$.

(a) 2 cosec $A$ (b) 2 sec $A$
(c) 2 sin $A$ (d) 2 cos $A$

**[SSC, 2013]**

10. If $r \sin\theta = 1$, $r\cos\theta=\sqrt{3}$, then the value of $(\sqrt{3}\tan\theta+1)$ is:

(a) $\sqrt{3}$ (b) $\frac{1}{\sqrt{3}}$
(c) 1 (d) 2

**[SSC, 2013]**

11. The angles of elevation of the top of a tower from the points $P$ and $Q$, at distances of '$a$' and '$b$' respectively from the base of the tower and in the same straight line with it are complementary. The height of the tower is:

(a) $\sqrt{ab}$ (b) $\frac{a}{b}$

(c) $ab$ (d) $a^2b^2$

**[SSC Assistant Grade III, 2013]**

**12.** A man from the top of a 100 m high tower sees a car moving towards the tower at an angle of depression of 30˚. After some time, the angle of depression becomes 60˚. The distance (in m) travelled by the car during this time is:

(a) $100\sqrt{3}$ (b) $\frac{200\sqrt{3}}{3}$

(c) $\frac{100\sqrt{3}}{3}$ (d) $200\sqrt{3}$

**[SSC Assistant Grade III, 2012]**

**13.** Two posts are $x$ m apart and the height of one is double that of the other. If from the midpoint of the line joining their feet, an observer finds the angular elevations of their tops to be complementary, then the height (in m) of the shorter post is:

(a) $\frac{x}{2\sqrt{2}}$ (b) $\frac{x}{4}$

(c) $x\sqrt{2}$ (d) $\frac{x}{\sqrt{2}}$

**[SSC, 2012]**

**14.** An aeroplane when flying at a height of 5000 m from the ground passes vertically above another aeroplane at an instant, when the angles of elevation of the two aeroplanes from the same point on the ground are 60° and 45° respectively. The vertical distance between the aeroplanes at that instant is:

(a) $5000\left(\sqrt{3}-1\right)$m (b) $5000\left(3-\sqrt{3}\right)$m

(c) $5000\left(1-\frac{1}{\sqrt{3}}\right)$m (d) 4500 m

**[SSC, 2012]**

**15.** The length of a shadow of a vertical tower is $\frac{1}{\sqrt{3}}$ times its height. The angle of elevation of the Sun is:

(a) 30° (b) 45°

(c) 60° (d) 90°

**[SSC, 2011]**

## ANSWER KEYS

### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (b) | **3.** (c) | **4.** (b) | **5.** (b) | **6.** (a) | **7.** (a) | **8.** (c) | **9.** (b) | **10.** (c) | **11.** (a) | **12.** (c) | **13.** (c) |
| **14.** (b) | **15.** (b) | **16.** (b) | **17.** (b) | **18.** (a) | **19.** (c) | **20.** (b) | **21.** (a) | **22.** (a) | **23.** (c) | **24.** (a) | **25.** (c) | **26.** (b) |
| **27.** (a) | **28.** (a) | **29.** (c) | **30.** (d) | | | | | | | | | |

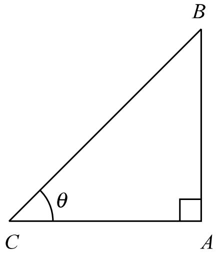
### Exercise-2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (a) | **3.** (b) | **4.** (a) | **5.** (d) | **6.** (a) | **7.** (b) | **8.** (d) | **9.** (a) | **10.** (d) | **11.** (a) | **12.** (b) | **13.** (a) |
| **14.** (c) | **15.** (c) | | | | | | | | | | | |

# EXPLANATORY ANSWERS

## EXERCISE-I

**1.** **(a)** Let, $AB$ be the rod and $AC$ be its shadow. $\angle ACB = \theta$. Let, $AB = x$.



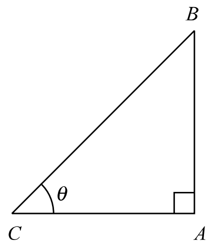

Then, $AC = \sqrt{3}x$.

$\therefore \quad \tan\theta = \dfrac{AB}{AC} = \dfrac{x}{\sqrt{3}x} = \dfrac{1}{\sqrt{3}} \quad \Rightarrow \quad \theta = 30°.$

**2.** **(b)** Let, $AB = x$.
Then, $AC = x$.

$\therefore \quad \tan\ \theta = \dfrac{AB}{AC} = 1$

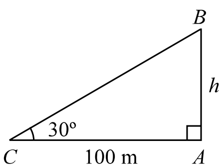
$\Rightarrow \quad \theta = 45°.$



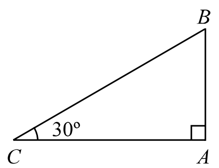

**3.** **(c)** $\tan\ 30° = \dfrac{h}{100}$

or, $\dfrac{1}{\sqrt{3}} = \dfrac{h}{100}$

or, $h = \dfrac{100}{\sqrt{3}}$ m.



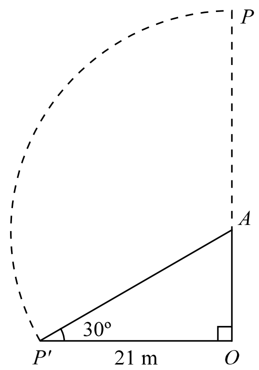

**4.** **(b)** Let, $AB$ be the building and $AC$ be its shadow. Then, $AB = 50$ m and $\theta = 30°$.




$\therefore \quad \dfrac{AC}{AB} = \cot 30° = \sqrt{3} \Rightarrow \dfrac{AC}{50} = \sqrt{3}$

$\Rightarrow \quad AC = 50\sqrt{3}$ m.

**5.** **(b)** Let, $OAP$ be the pole. When broken by wind at $A$, let its top $P$ strike the ground at $P'$ so that $OP' = 21$ m, $\angle OP'A = 30°$, $AP = AP'$.




We have, $\dfrac{OA}{OP'} = \tan 30° \quad \Rightarrow \quad OA = \dfrac{21}{\sqrt{3}}$.

$\therefore \quad OA = 7\sqrt{3}$.

Also, $\dfrac{AP'}{OP'} = \sec 30°$ or, $\dfrac{AP}{21} = \dfrac{2}{\sqrt{3}}$

$\therefore \quad AP = \dfrac{42}{\sqrt{3}} = 14\sqrt{3} = 14\sqrt{3}$.

Height of the pole $= OP = OA + AP$

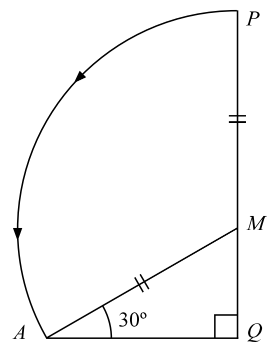
$= 7\sqrt{3} + 14\sqrt{3} = 21\sqrt{3}$.

**6.** **(a)** Let, $QMP$ be the tree. When broken by the wind, its top $P$ strikes the ground at $A$ such that $\angle QAM = 30°$, $AQ = 10$ m and $MA = MP$.

$\dfrac{MQ}{AQ} = \tan 30° \quad \Rightarrow \quad MQ = \dfrac{10}{\sqrt{3}}$ m

and, $\dfrac{AM}{AQ} = \sec 30° \quad \Rightarrow \quad AM = \therefore\ 10\left(\dfrac{2}{\sqrt{3}}\right) = \dfrac{20}{\sqrt{3}}$.

$\therefore$ Height of the tree:



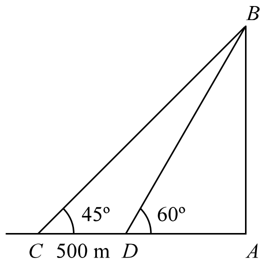

$= QM + MP = \text{QM} + AM = \dfrac{10}{\sqrt{3}} + \dfrac{20}{\sqrt{3}}$

$= \dfrac{30}{\sqrt{3}} = 10\sqrt{3} = 10\sqrt{3}$ m.

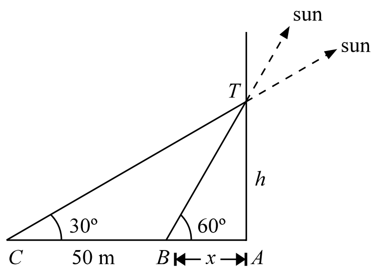
**7.** **(a)** $CD = AB\ (\cot 45° - \cot 60°)$

or, $$AB = \frac{CD}{\cot 45° - \cot 60°}$$

$$= \frac{500}{1 - \frac{1}{\sqrt{3}}} = \frac{500\sqrt{3}}{\sqrt{3}-1} \text{ m.}$$




**8.** **(c)** Let, $T$ be the top of the tower $AT$. Let, $AT = h$ m. Let, $AB$ and $AC$ be the shadows of the tower when the sun's altitude is 60° and 30°, respectively.




Then, $BC = 50$ m.

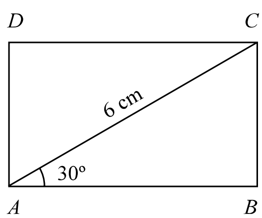
Let, $AB = x$ m. $\frac{x}{h} = \cot 60° \Rightarrow x = \frac{h}{\sqrt{3}}$ ...(1)

Also, $\frac{x+50}{h} = \cot 30° \Rightarrow x + 50 = \sqrt{3}\,h$ ...(2)

Subtracting Equation (1) from Equation (2),

$$50 = \left(\sqrt{3} - \frac{1}{\sqrt{3}}\right)h \Rightarrow h = 25\sqrt{3} \text{ m.}$$

**9.** **(b)** Let, $ABCD$ be the rectangle in which $\angle BAC = 30°$ and $AC = 6$ cm.

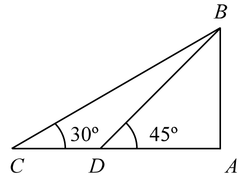



$$\frac{AB}{AC} = \cos 30° = \frac{\sqrt{3}}{2} \Rightarrow AB = 3\sqrt{3} \text{ cm.}$$

$$\frac{BC}{AC} = \sin 30° = \frac{1}{2} \Rightarrow BC = 3 \text{ cm.}$$

$\therefore$ Area of the rectangle $= AB \times BC = 9\sqrt{3}$ cm$^2$.

**10.** **(c)** Let, $AB$ be the tower and $AC$ and $AD$ be its shadows.




Then, $AB = 100$ m.

$$\frac{AD}{AB} = \cot 45° = 1 \Rightarrow \frac{AD}{100} = 1$$

$\Rightarrow AD = 100$ m.

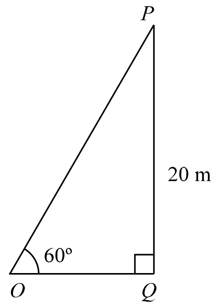
$$\frac{AC}{AB} = \cot 30° = \sqrt{3} \Rightarrow \frac{AC}{100} = \sqrt{3}$$

$\Rightarrow AC = 100\sqrt{3}$ m.

$\therefore\ x = AC - AD = 100(\sqrt{3} - 1)$ m.

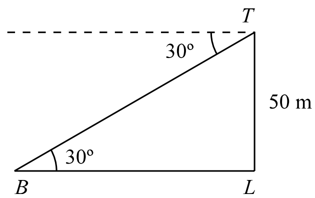
**11.** **(a)** $\sin 60° = \frac{PQ}{OP} \Rightarrow \frac{\sqrt{3}}{2} = \frac{20}{OP}$

$$\Rightarrow OP = 20 \times \frac{2}{\sqrt{2}} = \frac{40}{\sqrt{3}} \text{ m.}$$

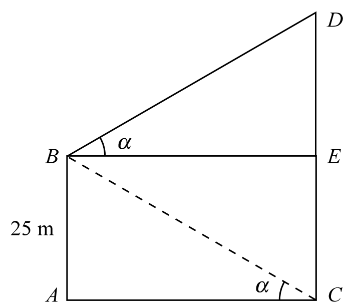



**12.** **(c)** $\tan 30° = \frac{TL}{BL} \Rightarrow \frac{1}{\sqrt{3}} = \frac{50}{BL}$

$\therefore\ BL = 50\sqrt{3}$ m.




**13.** **(c)** Let, $AB$ be the cliff and $CD$ be the tower. From $B$, draw $BE \perp CD$.



$$\frac{DE}{BE} = \tan\alpha \text{ and } \frac{AB}{AC} = \tan\alpha$$

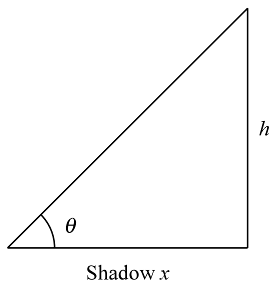
$\therefore \quad \dfrac{DE}{BE} = \dfrac{AB}{AC}$

$\therefore \quad DE = AB \qquad (\because\ BE = AC)$

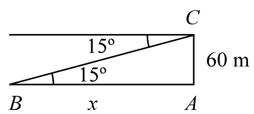
$\therefore \quad CD = CE + DE = AB + AB = 2AB = 50$ m.

**14.** **(b)** Since $\dfrac{h}{x} = \tan\theta$ and $h = x$.

$\therefore \quad \tan\theta = 1 \quad \Rightarrow \quad \theta = 45°$.




**15.** **(b)** Here, $B$ is the position of boat and $AC$ is lighthouse.



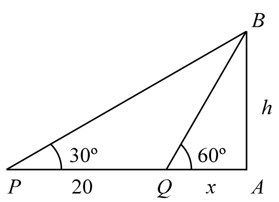

Now, $\dfrac{AC}{x} = \tan 15° = \tan(45° - 30°)$

$$= \frac{1 - \tan 30°}{1 + \tan 30°} = \frac{1 - \frac{1}{\sqrt{3}}}{1 + \frac{1}{\sqrt{3}}}$$

$\therefore \quad x = 60\left(\dfrac{\sqrt{3}+1}{\sqrt{3}-1}\right)$ m.

**16.** **(b)** $\dfrac{h}{x} = \tan 60° = \sqrt{3}$ .

$\therefore \quad h = \sqrt{3}\,x. \qquad \dfrac{h}{20+x} = \tan 30° = \dfrac{1}{\sqrt{3}}$

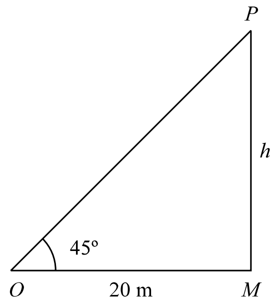



$\therefore \quad \sqrt{3}\,h = 20 + x$

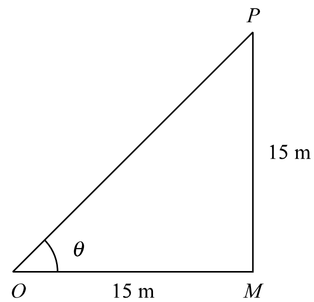
$\therefore \quad \sqrt{3}\,(\sqrt{3}\,x) = 20 + x$ or, $3x = 20 + x$

$\therefore \quad x = 10. \quad \therefore \quad h = 10\sqrt{3}$ m.

**17.** **(b)** Clearly, $\dfrac{h}{20} = \tan 45° = 1 \quad \therefore \quad h = 20$ m.

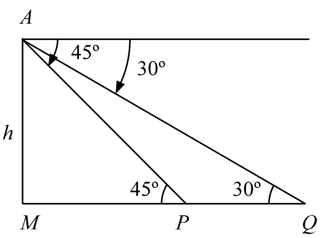



**18.** **(a)** Let, $MP$ denote the house. Let, $\theta$ be the angle of elevation.




$\therefore \quad \tan\theta = \dfrac{MP}{OM} = \dfrac{15}{15} = 1. \quad \therefore \quad \theta = 45°$.

**19.** **(c)** Let, the boats be at $P$, $Q$. So that $PQ = 60$ m. Let, $MA$ be the lighthouse.




Let, $h = MA$.

Then, $\dfrac{h}{MP} = \tan 45° = 1. \quad \therefore \quad h = MP$

Again, $\dfrac{h}{MP+60} = \tan 30° = \dfrac{1}{\sqrt{3}}$ .

$\therefore \quad MP + 60 = \sqrt{3}\,h$ or, $h + 60 = \sqrt{3}\,h$

$\therefore \quad (\sqrt{3} - 1)h = 60$

$\therefore \quad h = \dfrac{60}{\sqrt{3}-1} = \dfrac{60(\sqrt{3}+1)}{2} = 30(\sqrt{3} + 1)$ m

**20.** **(b)** The distance of the foot from each vertex $= h\cot\alpha$.

$\therefore$ The foot is at the circumcentre of the triangle.

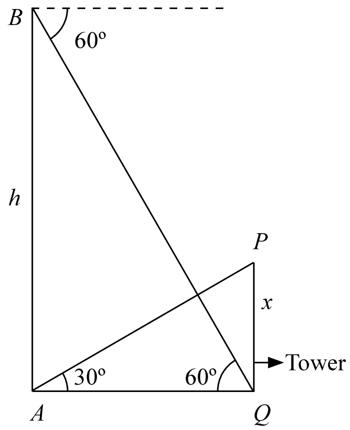
$\therefore \quad R = h\cot\alpha$

$\therefore \quad h = R\tan\alpha = \dfrac{a}{2\sin\alpha}\tan\alpha = \dfrac{a}{2}\tan\alpha \cdot \operatorname{cosec}\alpha$ .

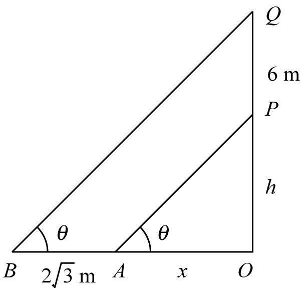
**21.** **(a)** Let, $PQ = x$ m denote the tower, so that $\angle PAQ = 30°$. Let, $BA = h$ m.

$\therefore \quad \angle BQA = 60°$.

Now, $\dfrac{h}{AQ} = \tan 60° = \sqrt{3}$. $\quad \therefore \quad AQ = \dfrac{h}{\sqrt{3}} = h\cot 60°$.




**22.** **(a)** Let, $OP$ be the tower of height $h$ m and $PQ$ be the flagstaff of height 6 m. Let, the sun make an angle $\theta$ with the ground. Let, $OA = x$ and $AB = 2\sqrt{3}$ be the shadows of the tower and the flagstaff, respectively.




Now, $\tan\theta = \dfrac{h}{x}$.

Also, $\dfrac{h+6}{x+2\sqrt{3}} = \tan\theta$

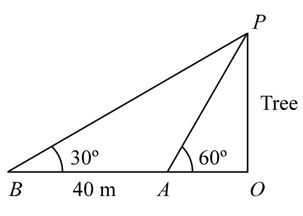
$\therefore \quad \dfrac{h}{x} = \dfrac{h+6}{x+2\sqrt{3}} \quad \Rightarrow \quad hx + 2\sqrt{3}\,h = hx + 6x$

$\Rightarrow \quad 2\sqrt{3}\,h = 6x$

$\Rightarrow \quad \dfrac{h}{x} = \dfrac{6}{2\sqrt{3}} = \sqrt{3}$

$\Rightarrow \quad \tan\theta = \sqrt{3}$. $\quad \therefore \quad \theta = 60°$.

**23.** **(c)** Let, $OA$ denote the breadth of the river.




$\dfrac{OP}{OA} = \tan 60° = \sqrt{3}$

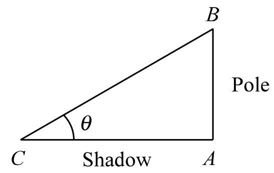
$\therefore \quad OP = \sqrt{3}\,OA$.

Also, $\dfrac{OP}{OA+40} = \tan 30° = \dfrac{1}{\sqrt{3}}$

$\therefore \quad OA + 40 = \sqrt{3}\,OP = \sqrt{3}\,(\sqrt{3}\,OA) = 3\,OA$.

$\therefore \quad 2OA = 40 \quad \Rightarrow \quad OA = 20$ m.

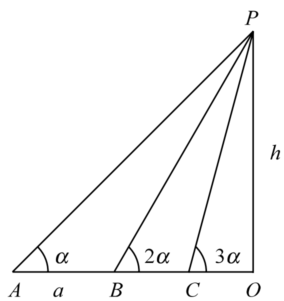
**24.** **(a)** Given, $AC = \sqrt{3}\,AB$.




$\therefore \quad \cot\theta = \dfrac{AC}{AB} = \sqrt{3} \quad \Rightarrow \quad \tan\theta = \dfrac{1}{\sqrt{3}}$

$\Rightarrow \quad \theta = 30°$.

**25.** **(c)** Let, $OP$ be a vertical tower. The elevation of top $P$ from $A$, $B$, $C$ are $\alpha$, $2\alpha$, $3\alpha$, respectively. $\angle APB = 2\alpha - \alpha = \angle PAB$.



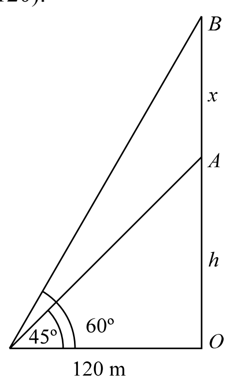

$\dfrac{OP}{BP} = \sin 2\alpha$

$\therefore \quad OP = BP\,\sin 2\alpha = a\sin 2\alpha$.

Thus, height of the tower $= a\sin 2\alpha$.

**26.** **(b)** $\dfrac{h+x}{120} = \tan 60° = \sqrt{3}$

$h + x = \sqrt{3}\,(120)$.

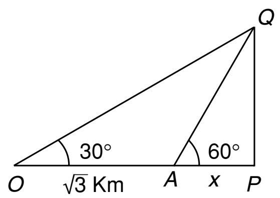



Also, $\dfrac{h}{120} = \tan 45° = 1$.

$\therefore \quad h = 120$ m $\quad \therefore \quad 120 + x = 120\sqrt{3}$.

$\therefore \quad x = 120(\sqrt{3} - 1)$ m.

**27. (a)** $\dfrac{h}{x} = \tan 60 = \sqrt{3}$. $\quad \therefore \quad h = \sqrt{3}\,x$.




Also, $\dfrac{h}{\sqrt{3}+x} = \tan 30° = \dfrac{1}{\sqrt{3}}$

$\therefore \quad \sqrt{3}\,h = \sqrt{3} + x$

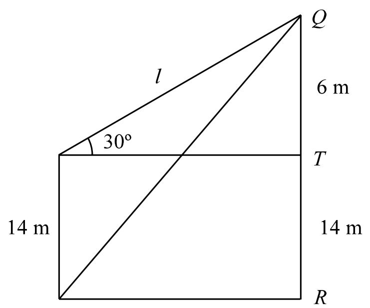
$\therefore \quad \sqrt{3}\,(\sqrt{3}\,x) = \sqrt{3} + x$, or, $3x - x = \sqrt{3}$

$\therefore \quad 2x = \sqrt{3} \quad \therefore \quad x = \dfrac{\sqrt{3}}{2}$

$\therefore \quad h = \sqrt{3}\,.\dfrac{\sqrt{3}}{2} = \dfrac{3}{2}$ Km.

**28. (a)** $\dfrac{6}{l} = \sin 30° = \dfrac{1}{2}$

$\therefore \quad l = 12$ m.




**29. (c)** Let, $h$ be the height of the man.

$\therefore \quad \dfrac{1}{2} = \dfrac{h}{2.4} \Rightarrow h = \dfrac{3}{4}\ (2.4) = 1.8$ m.

**30. (d)** Let, $AB = h$ be the height of the tower.

Let, $GA = x$.

Then, $\dfrac{h}{x} = \tan 30° = \dfrac{1}{\sqrt{3}}$.

$\therefore \quad h = \dfrac{x}{\sqrt{3}}$.

Also, $\dfrac{h}{x-20} = \tan 60° = \sqrt{3}$.

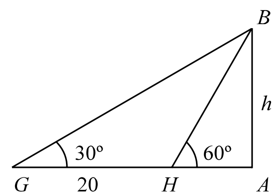
$\therefore \quad h = \sqrt{3}\,(x - 20)$

$\therefore \quad \dfrac{x}{\sqrt{3}} = \sqrt{3}\,(x - 20)$

$\Rightarrow \quad x = 3(x - 20)$

$\quad = 3x - 60$

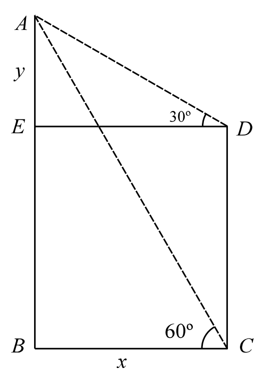
$\Rightarrow \quad 2x = 60 \quad \Rightarrow \quad x = 30$.




$\therefore \quad h = \dfrac{30}{\sqrt{3}} = 10\sqrt{3}$ m.

## Exercise-2
## (Based on Memory)

**1. (c)** Let, $AB$ be the tower and $CD$ be the electric pole.




Let, $BC = DE = x$.

Now, $\dfrac{AB}{BC} = \tan 60°$.

$\Rightarrow \quad \dfrac{15}{x} = \sqrt{3} \quad \Rightarrow \quad x = \dfrac{15}{\sqrt{3}}$.

Also, $\dfrac{AE}{DE} = \tan 30°$

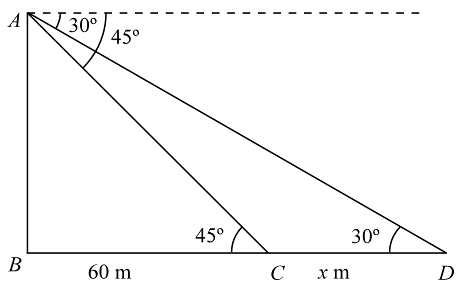
$\Rightarrow \quad \dfrac{y}{15/\sqrt{3}} = \dfrac{1}{\sqrt{3}}$

$\Rightarrow \quad 3y = 15$ or, $y = 5$.

$\therefore \quad CD = BE = AB - AE = 15 - 5 = 10$ m.

**2.** **(a)** $\tan 45° = \dfrac{AB}{60} \Rightarrow AB = 60$ m ...(1)

$\tan 30° = \dfrac{AB}{60+x}$, or, $AB = \dfrac{1}{\sqrt{3}}(60+x)$ ...(2)



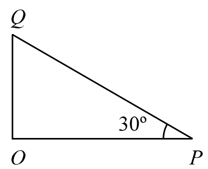

From Equation (1) and Equation (2), $60 + x = 60\sqrt{3}$

$\Rightarrow x = 60(\sqrt{3} - 1) = 43.92$ m $(\because \sqrt{3} = 1.732)$

Speed of the boat $= \dfrac{43.92}{5}$ m/s $= \dfrac{43.92}{5} \times \dfrac{18}{5} = 32$ Km/h.

**3.** **(b)** Let, $OQ$ be the tower.

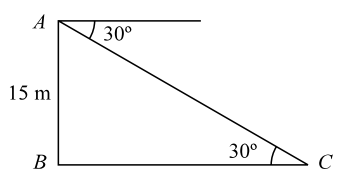
Then, $OQ = 100$ m and $\angle OPQ = 30°$.




In $\Delta OPQ$, $\tan 30° = \dfrac{OQ}{OP} \Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{100}{OP}$

$\Rightarrow OP = 100\sqrt{3}$ m.

**4.** **(a)** Let, $C$ be the initial position of the boat, and $A$ be the point on the top of the bridge from where the angle of depression of the boat is 30°.

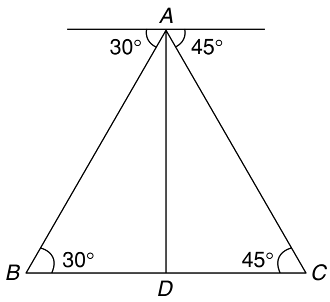



$AB = 15$ m, $BC = \dfrac{AB}{\tan 30°} = \dfrac{15}{1/\sqrt{3}} = 15\sqrt{3}$ m.

Speed of the boat = 6 Km/h $= 6 \times \dfrac{5}{18}$ m/s $= \dfrac{5}{3}$ m/s

$\therefore$ Time required $= \dfrac{\text{Distance}}{\text{Speed}} = \dfrac{15\sqrt{3}}{5/3} = 9\sqrt{3}$ second.

**5.** **(d)**




Let, $AD$ be the tower and $B$ and $C$ be two objects.

$\angle ABD = 30°$ and $\angle ACD = 45°$

$AD = 180$ m

From $\Delta ABD$,

$$\tan 30° = \frac{AD}{BD}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{180}{BD}$$

$$\Rightarrow BD = 180\sqrt{3} \text{ m}$$

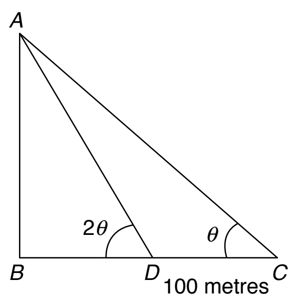
From $\Delta ADC$,

$$\tan 45° = \frac{AD}{DC}$$

$$\Rightarrow 1 = \frac{180}{DC} \Rightarrow DC = 180 \text{ m}$$

$$\therefore BC = BD + DC = 180\sqrt{3} + 180$$
$$= 180(\sqrt{3}+1) \text{ m}$$

**6.** **(a)**




$AB$ = Tower = $h$ m

$CD = 100$ m; $BC = 160$ m

$\angle ACB = \theta \quad \therefore \quad \angle ADB = 26$

In $\Delta ABC$,

$$\tan\theta = \frac{AB}{BC} \Rightarrow \tan\theta = \frac{h}{160} \quad \ldots(1)$$

In $\Delta ABD$,

$$\tan 2\theta = \frac{AB}{BD} = \frac{h}{60}$$

$$\Rightarrow \frac{2\tan\theta}{1-\tan^2\theta} = \frac{h}{60} \Leftrightarrow \frac{2\times\frac{h}{160}}{1-\frac{h^2}{160\times160}} = \frac{h}{60}$$

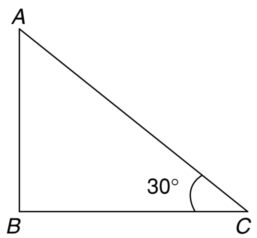
$$\Rightarrow \frac{1}{80\left(1-\frac{h^2}{160\times160}\right)} = \frac{1}{60}$$

$$\Rightarrow 4\left(1-\frac{h^2}{160\times160}\right) = 3$$

$$\Rightarrow \frac{h^2}{160\times160} = 1-\frac{3}{4} = \frac{1}{4} \Leftrightarrow h^2 = 6400$$

$$\Rightarrow h = \sqrt{6400} = 80 \text{ m}$$

**7. (b)**




$AB$ = Tower = $h$ m

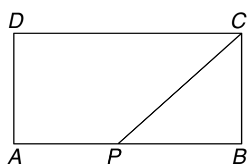
$BC$ = 50 m

$\angle ACB$ = 30°

$$\therefore \tan 30° = \frac{AB}{BC}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{AB}{50} \Leftrightarrow AB = \frac{50}{\sqrt{3}} \text{ m}$$

**8. (d)**




$AB$ = $3x$ units

$BC$ = $2x$ units

$$PB = \frac{3}{2}x \text{ units}$$

$$\text{CP} = \sqrt{PB^2 + BC^2} = \sqrt{\frac{9x^2}{4} + 4x^2}$$

$$= \sqrt{\frac{25x^2}{4}} = \frac{5x}{2} \text{ units}$$

$$\therefore \sin\angle CPB = \frac{BC}{CP} = \frac{2x}{\frac{5x}{2}} = \frac{4}{5}$$

**9. (a)** $$\frac{\sin A}{1+\cos A} + \frac{\sin A}{1-\cos A}$$

$$= \frac{\sin A(1-\cos A) + \sin A(1+\cos A)}{(1+\cos A)(1-\cos A)}$$

$$= \frac{\sin A - \sin A\cos A + \sin A + \sin A\cos A}{1+\cos^2 A}$$

$$= \frac{2\sin A}{\sin^2 A} = 2\operatorname{cosec} A$$

**10. (d)** $r \sin\theta = 1$

$$r\cos\theta = \sqrt{3}$$

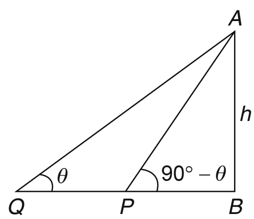
$$\Rightarrow \frac{\sin\theta}{\cos\theta} = \tan\theta = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \tan\theta = \tan 30° \Rightarrow \theta = 30°$$

$$\therefore \sqrt{3}\tan\theta + 1 = \sqrt{3}\times\tan 30° + 1$$

$$= \sqrt{3}\times\frac{1}{\sqrt{3}} + 1 = 1 + 1 = 2$$

**11. (a)**




$AB$ = Tower = $h$ units

$\therefore \angle AQB = \theta \therefore \angle APB = 90° - \theta$

$PB = a$; $BQ = b$

From $\Delta AQB$,

$$\tan\theta = \frac{AB}{BQ}$$

$$\Rightarrow \tan\theta = \frac{h}{b} \quad \ldots(1)$$

From $\Delta APB$,

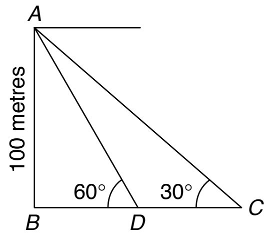
$$\tan(90° - \theta) = \frac{h}{PB}$$

$$\Rightarrow \quad \cot\theta = \frac{h}{a} \qquad \ldots(2)$$

By multiplying both the equations, we have $\tan\theta \cdot \cot\theta = \frac{h}{b} \times \frac{h}{a}$

$$\Rightarrow \quad h^2 = ab \Leftrightarrow h = \sqrt{ab}$$

**12. (b)**




$C$ = Initial point and

$D$ = Final point

$AB$ = Tower = 100 m

Let $CD$ be $x$ m.

From $\Delta ABD$,

$$\tan 60° = \frac{AB}{BD}$$

$$\Rightarrow \quad \sqrt{3} = \frac{100}{BD}$$

$$\Rightarrow \quad BD = \frac{100}{\sqrt{3}} \text{ m}$$

From $\Delta ABC$,

$$\tan 30° = \frac{AB}{BC}$$

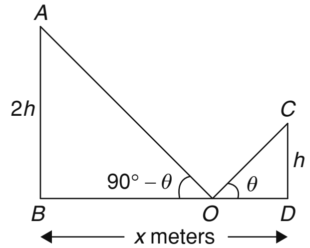
$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{100}{\frac{100}{\sqrt{3}} + x}$$

$$\Rightarrow \quad \frac{100}{\sqrt{3}} + x = 100\sqrt{3}$$

$$\therefore x = 100\sqrt{3} - \frac{100}{\sqrt{3}}$$

$$= \frac{300 - 100}{\sqrt{3}} = \frac{200}{\sqrt{3}} = \frac{200\sqrt{3}}{3} \text{ m}$$

**13. (a)** $CD = h$ m, $AB = 2h$ m




$$OB = OD = \frac{x}{2} \text{ m}$$

From $\Delta OCD$, $\tan\theta = \frac{h}{\frac{x}{2}} = \frac{2h}{x} \qquad \ldots(1)$

From $\Delta OAB$, $\tan(90° - \theta) = \frac{AB}{BO}$

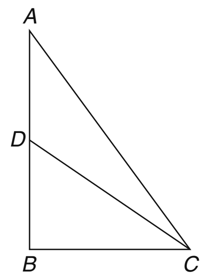
$$\Rightarrow \cot\theta = \frac{2h}{\frac{x}{2}} = \frac{4h}{x} \qquad \ldots(2)$$

Multiplying both equations,

$$\tan\theta \cdot \cot\theta = \frac{2h}{x} \times \frac{4h}{x}$$

$$\Rightarrow \quad x^2 = 8h^2 \qquad \Rightarrow \quad h^2 = \frac{x^2}{8} \Rightarrow h = \frac{x}{2\sqrt{2}} \text{ m}$$

**14. (c)**




$\angle ACB = 60°$

$\angle DCB = 45°$

$AB = 5000$ m

$AD = x$ m

$\therefore$ From $\Delta ABC$, $\tan 60° = \frac{AB}{BC}$

$$\Rightarrow \quad \sqrt{3} = \frac{5000}{BC}$$

$$\Rightarrow \quad BC = \frac{5000}{\sqrt{3}} \text{ m}$$

From $\Delta DBC$, $\tan 45° = \frac{DB}{BC}$

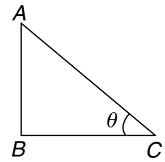
$$\Rightarrow \quad DB = BC = \frac{5000}{\sqrt{3}}$$

$$\therefore \quad AD = AB - BD = 5000 - \frac{5000}{\sqrt{3}}$$

$$= 5000\left(1 - \frac{1}{\sqrt{3}}\right)$$

$$= 5000\left(\frac{\sqrt{3}-1}{\sqrt{3}}\right) \text{ m}$$

**15. (c)**




Let, $AB$ be tower and N$C$ be its shadow.

If $AB = x$, then $BC = \frac{x}{\sqrt{3}}$

$$\therefore \quad \tan\theta = \frac{AB}{BC} = \frac{x}{\frac{x}{\sqrt{3}}} = \sqrt{3}$$

$$\therefore \quad \tan\theta = \tan 60°$$

$$\Rightarrow \quad \theta = 60°$$

# Plane Geometry

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## SECTION I LINES AND ANGLES

**Line** A geometrical straight line is a set of points that extends endlessly in both the directions.

**Axiom-1** A line contains infinitely many points.

**Axiom-2** Through a given point, infinitely many lines pass.

**Axiom-3** Given two distinct points $A$ and $B$, there is one and only one line that contains both the points.

**Parallel Lines** If two lines have no point in common, they are said to be *parallel lines*

**Intersecting Lines** If two lines have a point in common, they are said to be *intersecting lines*. Two lines can intersect at the most at one point.

**Line Segment and Ray** A part (or portion) of a line with two end points is called a *line segment* and a part of a line with one end point is called a *ray*. A line segment $\overline{AB}$ and its length is denoted as $AB$. Ray $AB$ (i.e., $A$ towards $B$) is denoted as $\overrightarrow{AB}$ and ray $BA$ (i.e., $B$ towards $A$) is denoted as $\overrightarrow{BA}$.

**Collinear Points** Three or more than three points are said to be *collinear* if there is a line which contains them all.

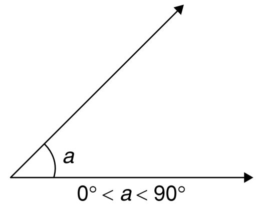
**Concurrent Lines** Three or more than three lines are said to be *concurrent* if there is a point which lies on all of them.

**Angle** An *angle* is a figure formed by two rays with a common initial point. The two rays forming an angle are called *arms* of the angle and the common initial point is called *vertex* of the angle.

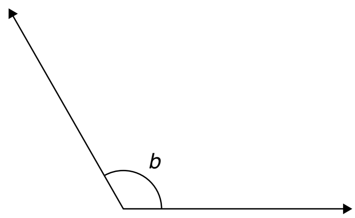
### Types of Angles

An angle is said to be:

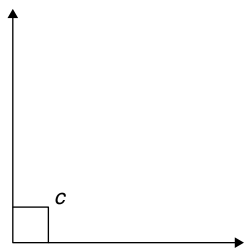
(i) *Acute*, if $a < 90^\circ$.



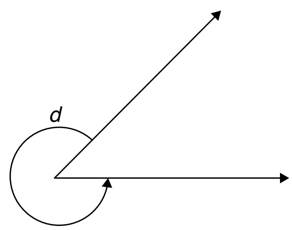

(ii) *Obtuse*, if $90^\circ < b < 180^\circ$.



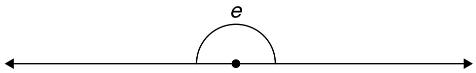

(iii) *Right angle*, if $c = 90^\circ$




(iv) *Reflex angle*, if $180^\circ < d < 360^\circ$




(v) *Straight angle*, if $e = 180^\circ$




(vi) *Complete angle*: An angle whose measure is 360º, is called a *complete angle*.

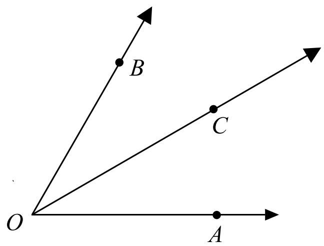
**Complementary Angles** Two angles, the sum of whose measures is 90º, are called *complementary angles,* e.g. 50º and 40º is a pair of complementary angles.

**Supplementary Angles** Two angles, the sum of whose measures is 180º, are called *supplementary angles*, e.g. 72º and 108º is a pair of supplementary angles.

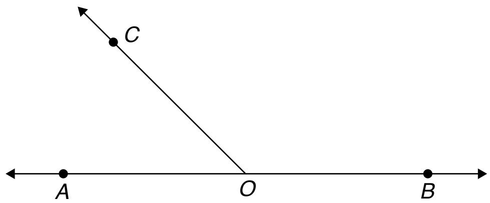
**Adjacent Angles** Two angles are called *adjacent angles* if

(i) they have the same vertex.
(ii) they have a common arm.
(iii) uncommon arms are on either side of the common arm.

E.g. $\angle AOC$ and $\angle BOC$ are adjacent angles.

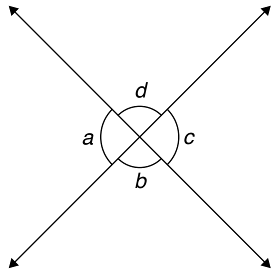



**Linear Pair:** Two adjacent angles are said to form a linear pair of angles if their non-common arms are two opposite rays.
E.g. $\angle AOC$ and $\angle BOC$ form a linear pair.




**Linear Pair Axiom:** If a ray stands on a line, then the sum of the two adjacent angles so formed is 180º. Conversely, if the sum of two adjacent angles is 180º; then the non-common arms of the angles are two opposite rays.

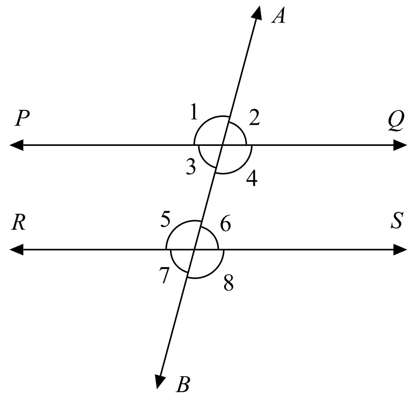
**Vertically Opposite Angles:** When two lines intersect, four angles are formed. The angles opposite to each other are called *vertically opposite angles*.




$a$ and $c$ are vertically opposite angles, $\angle a = \angle c$.

$b$ and $d$ are vertically opposite angles, $\angle b = \angle d$.

**Angles made by a transversal* with two parallel lines** Suppose $PQ \parallel RS$ and a transversal $AB$ cuts them, then




(a) Pair of corresponding angles are (1 and $\angle 5$), ($\angle 2$ and $\angle 6$), ($\angle 4$ and $\angle 8$) and ($\angle 3$ and $\angle 7$)
(b) Pair of alternate angles are ($\angle 3$ and $\angle 6$) and ($\angle 4$ and $\angle 5$)
(c) Pair of interior angles (consecutive interior angles or cointerior angles) on the same side of the transversal are ($\angle 3$ and $\angle 5$) and ($\angle 4$ and $\angle 6$)

## Key Results to Remember

If two parallel lines are intersected by a transversal, then

(i) each pair of corresponding angles are equal.
(ii) each pair of alternate angles are equal.
(iii) interior angles on the same side of the transversal are supplementary.

**Triangle** A plane figure bounded by three lines in a plane is called a *triangle*.

*A line which intersects two or more lines at distinct points is called a transversal of the given lines.

## SECTION 2 TRIANGLES

### Types of Triangles (On the basis of sides)

**Scalene triangle** A triangle two of whose sides are equal is called a *scalene triangle*.

**Isosceles triangle** A triangle two of whose sides are equal in length is called an *isosceles triangle*.

**Equilateral triangle** A triangle all of whose sides are equal is called an *equilateral triangle*.

### Types of Triangles (On the basis of angles)

**Acute triangle** A triangle, each of whose angle is acute, is called an *acute triangle* or *acute-angled triangle*.

**Right triangle** A triangle with one right angle is called a *right triangle* or a *right-angled triangle*.

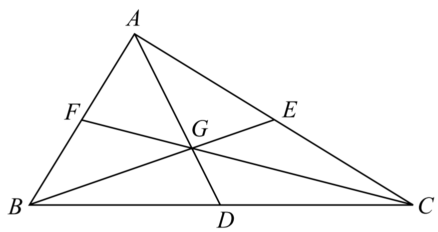
**Obtuse triangle** A triangle with one angle an obtuse angle, is known as *obtuse triangle* or *obtuse-angled triangle*.

### Some Important Terms Related to a Triangle

1. **Median** The median of a triangle corresponding to any side is the line segment joining the midpoint of that side with the opposite vertex.

   In the figure given below, *AD, BE* and *CF* are the medians.

   The medians of a triangle are concurrent i.e., they intersect each other at the same point.

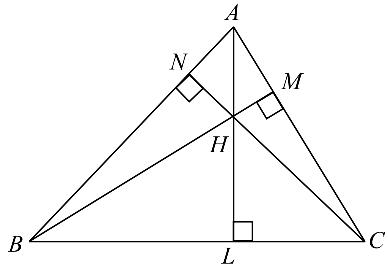



2. **Centroid** The point of intersection of all the three medians of a triangle is called its *centroid.*

   In the above figure $G$ is the centroid of $\Delta ABC$.

   **Note:** The centroid divides a median in the ratio 2:1.

3. **Altitudes** The *altitude* of a triangle corresponding to any side is the length of perpendicular drawn from the opposite vertex to that side.




In the figure given above, *AL*, *BM* and *CN* are the altitudes.

*Note:*

The altitudes of a triangle are concurrent.

4. **Orthocentre** The point of intersection of all the three altitudes of a triangle is called its *orthocentre*. In the figure given above $H$ is the orthocentre of $\Delta ABC$.

***Note:***

The orthocentre of a right-angled lies at the vertex containing the right angle.

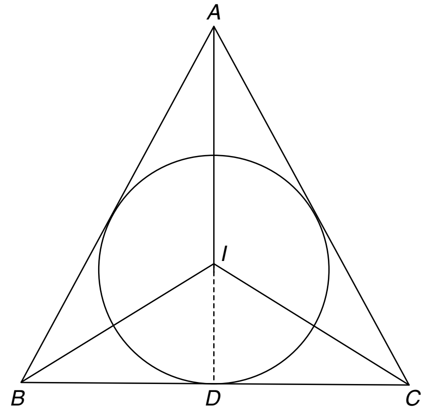
5. **Incentre of a triangle** The point of intersection of the internal bisectors of the angles of a triangle is called its *incentre*.

   In the figure given below, the internal bisectors of the angles of $\Delta ABC$ intersect at $I$.

   $\therefore$ $I$ is the Incentre of $\Delta ABC$.

   Let, $ID \perp BC$

   Then, a circle with centre $I$ and radius $ID$ is called the *incircle* of $\Delta ABC$.

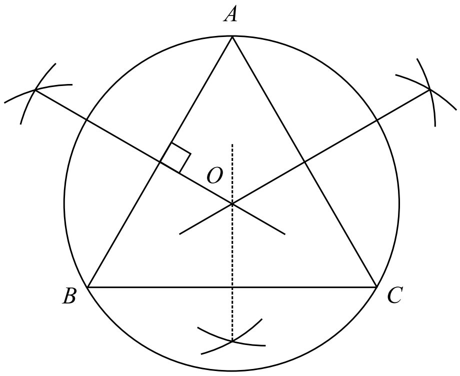



***Note:***

The incentre of a triangle is equidistant from its sides.

6. **Circumcentre of a triangle** The point of intersection of the perpendicular bisectors of the sides of a triangle is called its *circumcentre*.

   In the figure given below, the right bisectors of the sides of $\Delta ABC$ intersect at $O$.




$\therefore$ $O$ is the *circumcentre* of $\Delta ABC$ with $O$ as centre and radius equal to $OA = OB = OC$. We draw a circle passing through the vertices of the given $\Delta$. This circle is called the *circumcircle* of $\Delta ABC$.

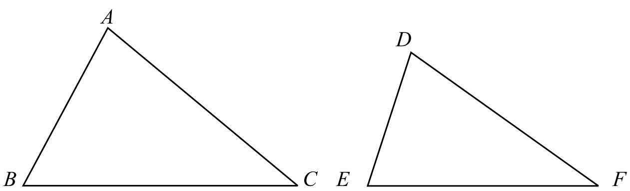
***Note:*** The circumcentre of a triangle is *equidistant* from its *vertices*.

### congruent triangles

Two triangles are *congruent* if and only if one of them can be superposed on the other, so as to cover it exactly.

Thus, congruent triangles are exactly identical

For example, If $\Delta ABC \cong \Delta DEF$ then we have




$\angle A = \angle D$, $\angle B = \angle E$, $\angle C = \angle F$;

and $AB = DE$, $BC = EF$ and $AC = DF$.

### Similar Triangles

**Congruent figures** Two geometric figures having the same shape and size are known as *congruent figures.*

**Similar figures** Two figures (plane or solid) are said to be *similar* if they have the same shape irrespective of their sizes.

*Note:* Two similar figures may not be congruent as their size may be different.

For examples,

1. Any two lines segments are similar.
2. Any two equilateral triangles are similar.
3. Any two squares are similar.
4. Any two circles are similar.
5. Any two rectangles are similar.

**Similar triangles** Two triangles are similar if
(a) their corresponding angles are equal.
(b) their corresponding sides are proportional.

## Key Results To Remember

1. The sum of all the angles round a point is equal to 360º.
2. Two lines parallel to the same line are parallel to each other.
3. The sum of three angles of a triangle is 180º.
4. If a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles. (Exterior Angle Theorem)
5. If two sides of a triangle are unequal, the longer side has greater angle opposite to it.
6. In a triangle, the greater angle has the longer side opposite to it.
7. The sum of any two sides of a triangle is greater than the third side.
8. If $a$, $b$, $c$ denote the sides of a triangle then
   (i) If $c^2 < a^2 + b^2$, triangle is acute angled.
   (ii) If $c^2 = a^2 + b^2$, triangle is right angled.
   (iii) If $c^2 > a^2 + b^2$, triangle is obtuse angled.
9. Two triangles are congruent if:
   (i) Any two sides and the included angle of one triangle are equal to any two sides and the included angle of the other triangle.
   (SAS congruence theorem)
   (ii) Two angles and the included side of one triangle are equal to the corresponding two angles and the included side of the other triangle.
   (ASA congruence theorem)
   (iii) The three sides of one triangle are equal to the corresponding three sides of the other triangle.
   (SSS congruence theorem)

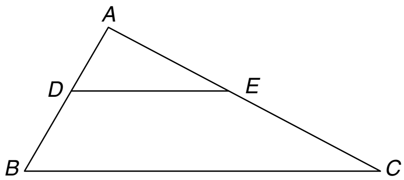
**Note:**

Two right triangles are congruent if the hypotenuse and one side of one triangle are respectively equal to the hypotenuse and the corresponding side of the other triangle.
(RHS Congruence theorem)

**10.** The line segments joining the mid-points of any two sides of a triangle is parallel to the third side and equal to half of it.

**11. Basic Proportionality Theorem** If a line is drawn parallel to one side of a triangle, to intersect the other two sides in distinct points, the other two sides are divided in the same ratio.

In the figure given below, In a $\Delta ABC$




If $DE \parallel BC$

Then, $\dfrac{AD}{DB} = \dfrac{AE}{EC}$

**Illustration 1:** In the figure given above, $D$ and $E$ are the points on the $AB$ and $AC$ respectively such that $DE \parallel BC$. If $AD = 8$ cm, $AB = 12$ cm and $AE = 12$ cm. Find $CE$

**Solution:** In $\Delta ABC$, $DE \parallel BC$

$$\frac{AD}{DB} = \frac{AE}{EC} \text{ (Basic Proportionality Theorem)}$$

$$\Rightarrow \quad \frac{8}{12-8} = \frac{12}{EC}$$

$$\Rightarrow \quad \frac{8}{4} = \frac{12}{EC}$$

or $\quad EC = 6$ cm

**12.** If a line divides any two sides of a triangle in the same ratio, the line is parallel to the third side.

**Explanation** In the above figure (given in point 11). In $\Delta ABC$

if $\dfrac{AD}{DB} = \dfrac{AE}{EC}$, then $DE \parallel BC$.

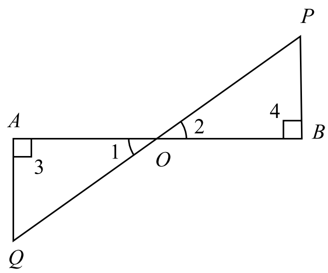
## Similarity Theorems

**13. AAA Similarity** If in two triangles, corresponding angles are equal, then the triangles are similar.

**Corollary** (AA-similarity): If two angles of one triangle are respectively equal to two angles of another triangle then the two triangles are similar.

**Illustration 2:** In the figure given below, $QA$ and $PB$ are perpendiculars to $AB$. If $AO = 15$ cm, $BO = 9$ cm, $PB = 12$ cm, find $AQ$.

**Solution:**




In $\Delta$s $AOQ$ and $BOP$

$\angle 1 = \angle 2$ [vertically opposite angles]

$\angle 3 = \angle 4$ [each 90º]

$\therefore \quad \Delta AOQ \sim \Delta BOP$ [$AA$ Similarity Criterion]

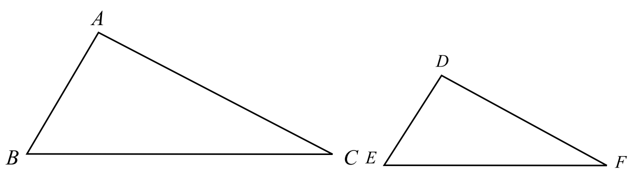
$\therefore \quad \dfrac{AO}{BO} = \dfrac{AQ}{BP}$ (corresponding sides of $\sim\Delta$s)

or $\quad \dfrac{15}{9} = \dfrac{AQ}{12}$

or $\quad \dfrac{5}{1} = \dfrac{AQ}{4} \Rightarrow AQ = 20$ cm.

**14. SSS-Similarity** If the corresponding sides of two triangles are proportional then they are similar.

**Explanation:** In $\Delta$s $ABC$ and $DEF$,

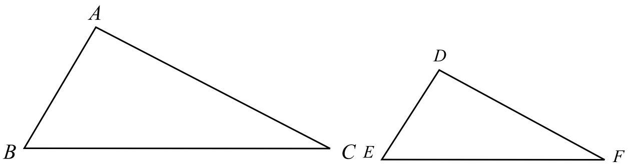


if $\dfrac{AB}{DE} = \dfrac{BC}{EF} = \dfrac{AC}{DF}$

Then $\Delta ABC \sim \Delta DEF$ [SSS Similarity]

**15. SAS-Similarity** If in two triangles, one pair of corresponding sides are proportional and the included angles are equal, then the two triangles are similar.

**Explanation** In $\Delta$s $ABC$ and $DEF$,



if $\angle A = \angle D$ and $\dfrac{AB}{DE} = \dfrac{AC}{DF}$

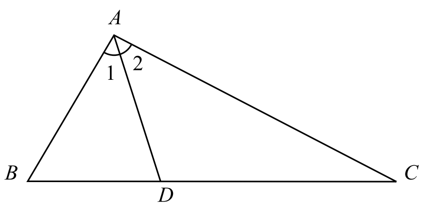
or $\angle B = \angle E$ and $\dfrac{AB}{DE} = \dfrac{BC}{EF}$

or $\angle C = \angle F$ and $\dfrac{AC}{DF} = \dfrac{BC}{EF}$,

then $\Delta ABC \sim \Delta DEF$ [SAS-Similarity]

**16. Internal Bisector Property** The internal bisector of an angle of a triangle divides the opposite side in the ratio of the sides containing the angle.

**Explanation** In $\Delta ABC$, if $\angle 1 = \angle 2$

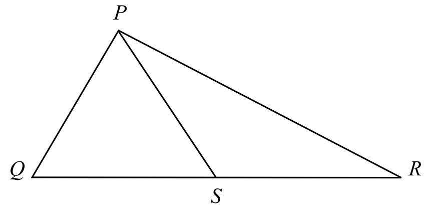


Then $\dfrac{AB}{AC} = \dfrac{BD}{CD}$

**17.** If a line segment drawn from the vertex of an angle of a triangle to its opposite side divides it in the ratio of the sides containing the angle, then the line segment bisects the angle.

**Illustration 3:** In $\Delta PQR$, $PQ = 6$ cm, $PR = 8$ cm,

**Solution:** $QS = 1.5$ cm, $RS = 2$ cm



$\therefore \quad \dfrac{PQ}{PR} = \dfrac{6}{8} = \dfrac{3}{4}$ and $\dfrac{QS}{RS} = \dfrac{1.5}{2} = \dfrac{3}{4}$

Thus, $\dfrac{PQ}{PR} = \dfrac{QS}{RS}$

$\therefore \quad PS$ is the bisector of $\angle P$.

**18. Pythagoras Theorem** In a right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.

**Explanation** In a right $\Delta ABC$, right angled at $B$

$$AC^2 = AB^2 + BC^2$$

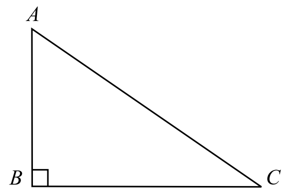
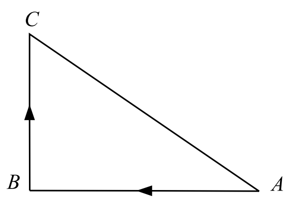


**Illustration 4:** a man goes 15 m west and then 8 m due north. How far is he from the starting point.

**Solution:** Let, the initial position of the man be $A$.



Let, $AB = 15$ m and $BC = 8$ m

$\therefore \quad AC^2 = AB^2 + BC^2$ (Pythagoras Theorem)

$= (15)^2 + (8)^2$

$= 225 + 64$

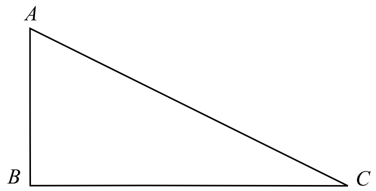
$= 289$

$$AC = \sqrt{289}$$
$$= 17 \text{ m}$$

Hence, the man is 17 m away from the starting point.

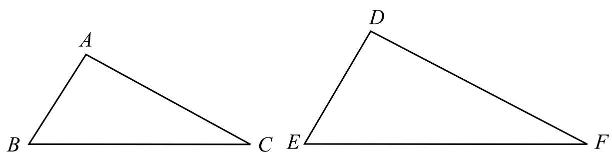
> **19. Converse of Pythagoras Theorem.** In a triangle, if the square of one side is equal to the sum of the squares of the other two sides, then the angle opposite the first side is a right angle.

**Explanation** In a $\Delta ABC$ if $AB^2 + BC^2 = AC^2$
Then, $\angle ABC = 90°$




> **20. Area Theorem** The ratio of the areas of two similar Ds is equal to the ratio of the squares of any two corresponding sides

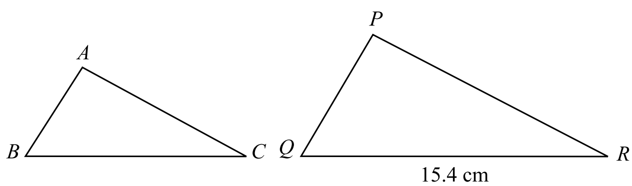
**Explanation** If $\Delta ABC \sim \Delta DEF$,




$$\text{then } \frac{ar(\Delta ABC)}{ar(\Delta DEF)} = \frac{AB^2}{DE^2} = \frac{AC^2}{DF^2} = \frac{BC^2}{EF^2}$$

**Illustration 5:** The areas of two similar Δs $ABC$ and $PQR$ are 64 cm$^2$ and 121 cm$^2$, respectively. If $QR$ = 15.4 cm, find $BC$.

**Solution:** Since $\Delta ABC \sim \Delta PQR$

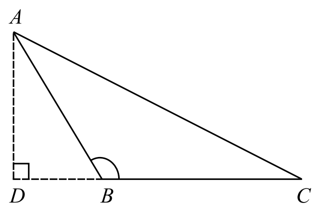



$$\therefore \quad \frac{ar(\Delta ABC)}{ar(\Delta PQR)} = \frac{BC^2}{QR^2} \quad \text{(Area Theorem)}$$

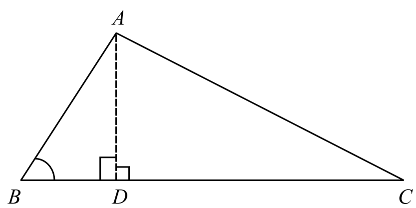
$$\text{i.e.,} \quad \frac{64}{121} = \frac{BC^2}{(15.4)^2} \Rightarrow \frac{8}{11} = \frac{BC}{15.4}$$

$$\therefore \quad BC = 11.2 \text{ cm}$$

> **21.** The ratio of the areas of two similar triangles is equal to the
> (i) ratio of the squares of the corresponding medians
> (ii) ratio of the squares of the corresponding altitudes
> (iii) ratio of the squares of the corresponding angle bisector segments
>
> **22.** If two similar triangles have equal areas, then the Ds are congruent.
>
> **23.** In two similar triangles, the ratio of two corresponding sides is same as the ratio of their perimeters.
>
> **24. Obtuse Angle Property** in a D$ABC$, if $\angle B$ is obtuse then $AC2 = AB2 + BC2 + 2\ BC \times BD$
> where $AD \perp BC$

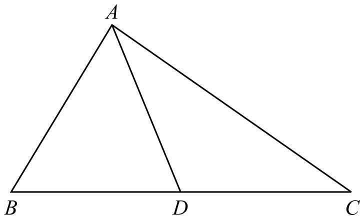



> **25. Acute Angle Property** In a D$ABC$, if $\angle C$ is acute, then $AB2 = AC2 + BC2 - 2BC \times CD$ where $AD \perp BC$




> **26. Apollonius Theorem** The sum of the squares on any two sides of a triangle is equal to the sum of twice the square of the median, which bisects the third side and half the square of the third side.

**Explanation** In the given $\Delta ABC$,



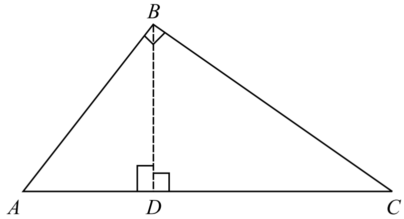
$$AB^2 + AC^2 = 2AD^2 + \frac{1}{2}BC^2$$

or $\quad AB^2 + AC^2 = 2[AD^2 + BD^2]$

**27.** If a perpendicular is drawn from the vertex of the right angle of a right triangle to the hypotenuse, the triangles on each side of the perpendicular are similar to the whole triangle and to each other. Also the square of the perpendicular is equal to the product of the lengths of the two parts of the hypotenuse.

**Explanation** In the figure given below,

$ABC$ is a right triangle, right angled at $B$ and $BD \perp AC$, then



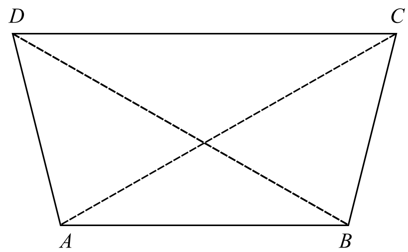
(i) $\Delta ADB \sim \Delta ABC$ ($AA$ Similarity)

(ii) $\Delta BDC \sim \Delta ABC$ ($AA$ Similarity)

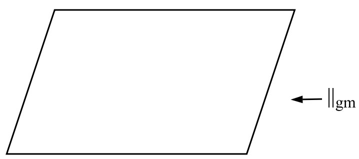
(iii) $\Delta ADB \sim \Delta BDC$ also $BD^2 = AD \times CD$

## SECTION 3 QUADRILATERALS AND PARALLELOGRAMS

**Quadrilateral** A plane figure bounded by four line segments $AB$, $BC$, $CD$ and $DA$ is called a *quadrilateral*, written as quad. $ABCD$ or $\angle ABCD$.

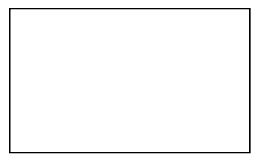


### Various types of Quadrilaterals



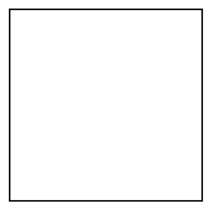
**(i) Parallelogram** A quadrilateral in which opposite sides are parallel is called *parallelogram*, written as $\|_{gm}$ .

**(ii) Rectangle** A parallelogram each of whose angles is 90° is called a *rectangle*, written as rect. $ABCD$.



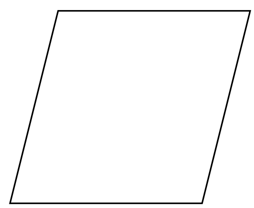
Rectangle

**(iii) Square** A rectangle having all sides equal is called a *square*.



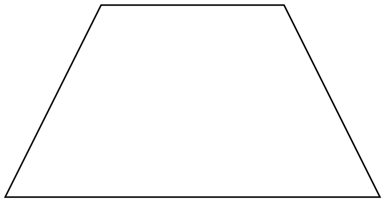
Square

**(iv) Rhombus** A quadrilateral having all sides equal is called a *rhombus*



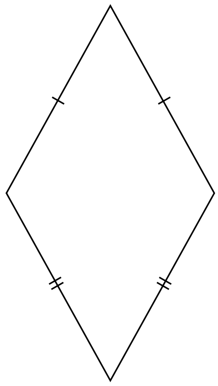
Rhombus

**(v) Trapezium** A quadrilateral in which two opposite sides are parallel and two opposite sides are non-parallel is called a *trapezium.*



Trapezium

**(vi) Kite** A quadrilateral in which pairs of adjacent sides are equal is known as *kite.*



## Key Results to Remember

**1.** The sum of all the four angles of a quadrilateral is 360°.

**2.** In a parallelogram
(i) opposite sides are equal.
(ii) opposite angles are equal.
(iii) each diagonal bisects the parallelogram.
(iv) the diagonal bisect each other.

**3.** A quadrilateral is a ||gm
(i) if both pairs of opposite sides are equal.
or (ii) if both pairs of opposite angles are equal.
or (iii) if the diagonals bisect each other.
or (iv) if a pair of opposite sides are equal and parallel.

**4.** The diagonals of a rectangle are equal.

**5.** If the diagonals of a ||gm are equal, it is a rectangle.

**6.** Diagonals of a rhombus are perpendicular to each other.

**7.** Diagonals of a square are equal and perpendicular to each other.

**8.** The figure formed by joining the mid-points of the pairs of consecutive sides of a quadrilateral is a ||gm.

**9.** The quadrilateral formed by joining the mid-points of the consecutive sides of a rectangle is a rhombus.

**10.** The quadrilateral formed by joining the mid-points of the consecutive sides of a rhombus is a rectangle.

**11.** If the diagonals of a quadrilateral are perpendicular to each other, then the quadrilateral formed by joining the mid-points of its sides, is a rectangle.

**12.** The quadrilateral formed by joining the mid-points of the sides of a square, is also a square.

# SECTION 4 POLYGONS

**Polygon** A closed plane figure bounded by line segments is called a *polygon.*

The line segments are called its *sides* and the points of intersection of consecutive sides are called its *vertices*. An angle formed by two consecutive sides of a polygon is called an *interior angle* or simply an *angle* of the polygon.

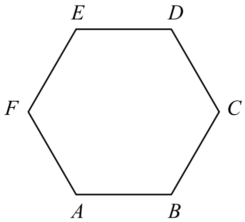
| *No. of sides* | *Name* |
|---|---|
| 3 | Triangle |
| 4 | Quadrilateral |
| 5 | Pentagon |
| 6 | Hexagon |
| 7 | Heptagon |
| 8 | Octagon |
| 9 | |
| 10 | Decagon |

A polygon is named according to the number of sides, it has.

In general, a polygon of $n$ sides is called *n-gon.* Thus, a polygon having 18 sides is called 18-gon.

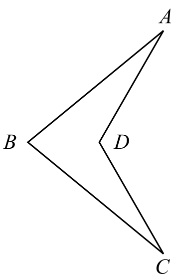
**Diagonal of a Polygon** Line segment joining any two non-consecutive vertices of a polygon is called its *diagonal*.

**Convex Polygon** If all the (interior) angles of a polygon are less than 180°, it is called a *convex polygon*. In the figure given below, *ABCDEF* is a convex polygon. In fact, it is a convex hexagon.



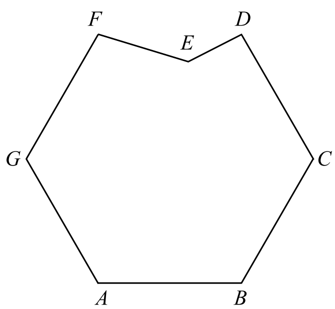

(In other words, a polygon is a convex polygon if the line segment joining any two points inside it lies completely inside the polygon).

**Concave Polygon** If one or more of the (interior) angles of a polygon is greater than 180° i.e., reflex, it is called

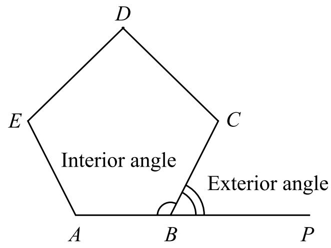



⇐ Concave polygon

*concave* (or re-entrant) *polygon* In the figure given below, *ABCDEFG* is a concave polygon. In fact, it is a concave heptagon.




**Exterior Angle of Convex Polygon** If we produce a side of polygon, the angle it makes with the next side is called an *exterior angle*. In the diagram given below, *ABCDE* is a pentagon. Its side *AB* has been produced to *P*, then $\angle CBP$ is an exterior angle.




**Note:**

Corresponding to each interior angle, there is an exterior angle. Also, as an exterior angle and its adjacent interior angle make a straight line, we have **an exterior angle + adjacent interior angle = 180°**

**Regular Polygon** A polygon is called regular polygon if all of its sides have equal length and all its angles have equal size.

Thus, in a regular polygon

(i) all sides are equal in length.

(ii) all interior angles are equal in size.

(iii) all exterior angles are equal size.

**Note:**

All regular polygons are convex.

## Key Results to Remember

**1.** (a) If there is a polygon of $n$ sides ($n \geq 3$), we can cut it into $(n - 2)$ triangles with a common vertex and so *the sum of the interior angles of a polygon of n sides would be*

$$(n - 2) \times 180° = (n - 2) \times 2 \text{ right angles}$$
$$= (2n - 4) \text{ right angles}$$

(b) If there is a regular polygon of $n$ sides ($n \geq 3$), then its each interior angle is equal to

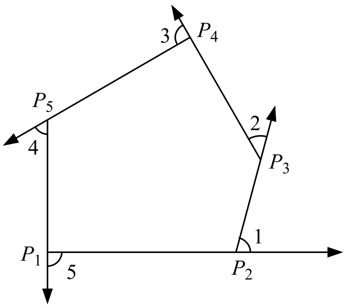
$$\left(\frac{2n-4}{n} \times 90\right)$$

(c) Each exterior angle of a regular polygon of $n$ sides is equal to

$$= \left(\frac{360}{n}\right)^{\circ}$$

**2.** The sum of all the exterior angles formed by producing the sides of a convex polygon in the same order is equal to four right angles.

**Explanation** If in a convex polygon $P_1P_2P_3P_4P_5$, all the sides are produced in order, forming exterior angles $\angle 1$, $\angle 2$, $\angle 3$, $\angle 4$ and $\angle 5$, then $\angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5 = 4$ right angles.




**3.** If each exterior angle of a regular polygon is $x°$, then the number of sides in the polygon $= \dfrac{360°}{x}$.

**Note:**

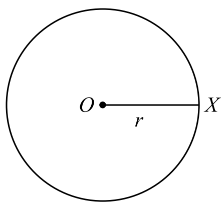
Greater the number of sides in a regular polygon, greater is the value of its each interior angle and smaller is the value of each exterior angle.

**4.** If a polygon has $n$ sides, then the number of diagonals of the polygon

$$= \frac{n(n-1)}{2} - n.$$

## SECTION 5 CIRCLES AND TANGENTS

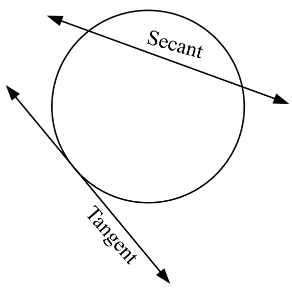
**Circle** A circle is a set of all those points in a plane, each one of which is at given constant distance from a given fixed point in the plane.




The fixed point is called the *centre* and the given constant distance is called the *radius* of the circle.

A circle with centre $O$ and radius $r$ is usually denoted by $C(O, r)$.

**Tangent** A line meeting a circle in only one point is called a *tangent* to the circle. The point at which the tangent line meets the circle is called the *point of contact*.

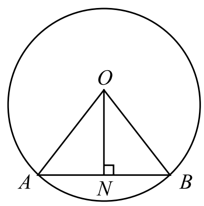



**Secant** A line which intersects a circle in two distinct points is called a *secant line*.

### Key Results to Remember

**1.** The perpendicular from the centre of a circle to a chord bisects the chord.

**Explanation** If $ON \perp AB$, then $AN = NB$.

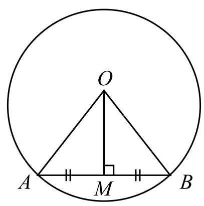



**Note:**

The converse of above theorem is true and can be stated as point 2.

**2.** The line joining the centre of a circle to the midpoint of a chord is perpendicular to the chord.

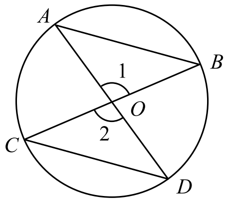
**Explanation** If $AM = MB$, then $OM \perp AB$.




**Cor.** The perpendicular bisectors of two chords of a circle intersect at its centre.

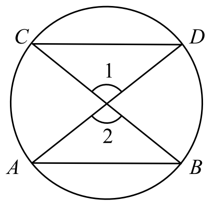
> **3.** Equal chords of a circle subtend equal angles at the centre.

**Explanation** If $AB = CD$, then $\angle 1 = \angle 2$



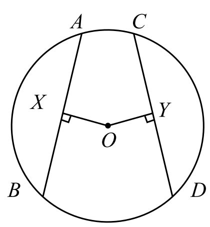

> **4.** (Converse of above theorem) If the angles subtended by two chords at the centre of a circle are equal then the chords are equal.

**Explanation** If $\angle 1 = \angle 2$, then $AB = CD$



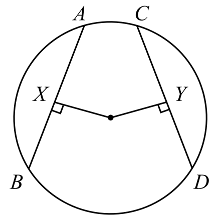

> **5.** Equal chords of a circle are equidistant from the centre.

**Explanation** If the chords $AB$ and $CD$ of a circle are equal and if $OX \perp AB$ and $OY \perp CD$ then $OX = OY$.



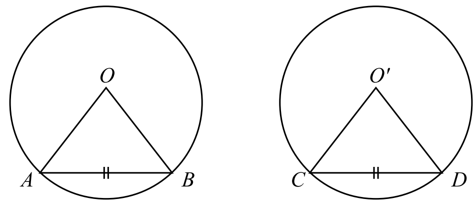

> **6.** (Converse above theorem) Chords equidistant from the centre of the circle are equal.

**Explanation** If $OX \perp AB$ $OY \perp CD$ and $OX = OY$, then chords $AB = CD$



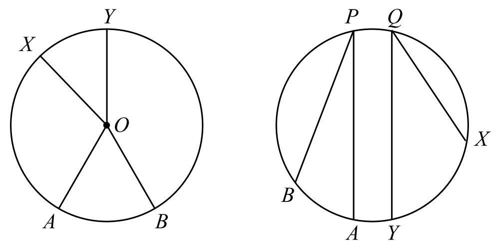

> **7.** In equal circles (or in the same circle), equal chords cut of equal arcs.

**Explanation** If the chords $AB = CD$, then arc $AB$ = are $CD$.



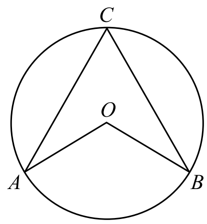

> **8.** In equal circles (or in the same circle) if two arcs subtend equal angles at the centre (or at the circum-ference), the arcs are equal.

**Explanation** If $\angle BOA = \angle XOY$, then arc $AB$ = arc $XY$ or if $\angle BPA = \angle XQY$, then arc $AB$ = arc $XY$.



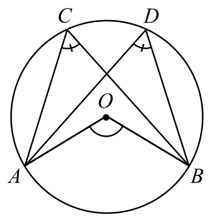

> **9.** The angle subtended by an arc of a circle at the centre is double the angle subtended by it at any point on the remaining part of the circle. (The theorem is popularly known as Degree Measure Theorem).

**Explanation** A circle, centre $O$, with $\angle AOB$ at the centre, $\angle ACB$ at the circumference, standing on the same arc $AB$, then $\angle AOB = 2\angle ACB$




**10.** Angles in the same segment of a circle are equal.

**Explanation** A circle, centre $O$, $\angle ACB$ and $\angle ADB$ are angles at the circumference, standing on the same arc, then

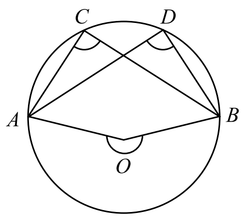



$\angle ACB = \angle ADB$

(angles in same arc)

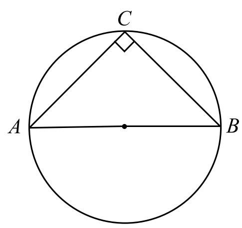
or

(angles in same segment)



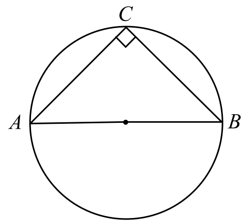

**11.** The angle in a semicircle is a right angle.

**Explanation** In the figure given below $\angle ACB = 90°$

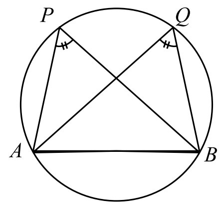



**12.** (Converse of above theorem) The circle drawn with hypotenuse of a right triangle as diameter passes through its opposite vertex.

**Explanation** The circle drawn with the hypotenuse $AB$ of a right triangle $ACB$ as diameter passes through its opposite vertex $C$.

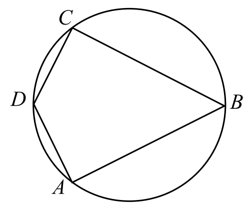



**13.** If $\angle APB = \angle AQB$, and if $P$, $Q$ are on the same side of $AB$, then $A$, $B$, $Q$, $P$ are concyclic i.e., lie on the same circle.




**14.** The sum of the either pair of the opposite angles of a cyclic quadrilateral is 180°.

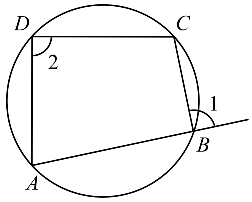
**Explanation** If $ABCD$ is a cyclic quadrilateral, then $\angle A + \angle C = \angle B + \angle D = 180°$




**15.** (Converse of above theorem) If the two angles of a pair of opposite angles of a quadrilateral are supplementary then the quadrilateral is cyclic.

**16.** If a side of a cyclic quadrilateral is produced then the exterior angle is equal to the interior opposite angle.

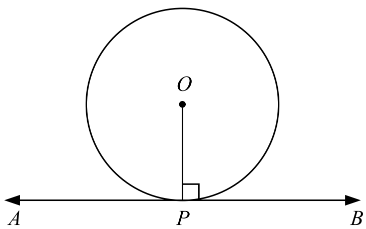
**Explanation** If the side $AB$ of a cyclic quadrilateral $ABCD$ is produced then $\angle 1 = \angle 2$.




## THEOREMS ON TANGENTS

> **17.** A tangent at any point of a circle is perpendicular to the radius through the point of contact.

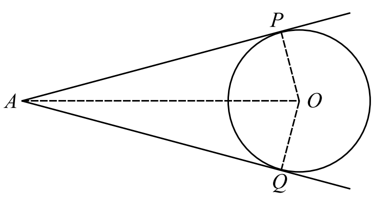
**Explanation** If $AB$ is a tangent at a point $P$ to a circle $C$ $(O, r)$ then $PO \perp AB$



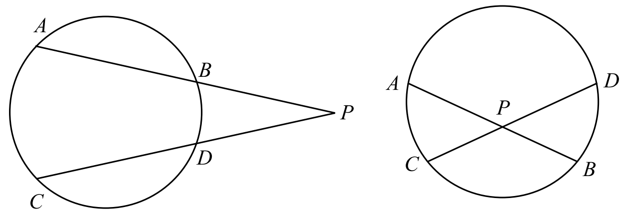

> **18.** (Converse of above theorem) A line drawn through the end of a radius and perpendicular to it, is a tangent to the circle.

> **19.** The lengths of two tangents drawn from an external point to a circle are equal.

**Explanation** If two tangents $AP$ and $AQ$ are drawn from a point A to a circle $C(O, r)$, then $AP = AQ$

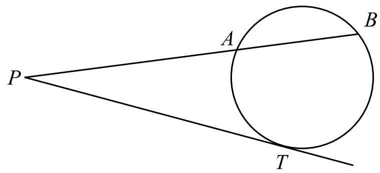



> **20.** If two chords $AB$ and $CD$ intersect internally (ii) or externally (i) at a point $P$ then
> $$PA \times PB = PC \times PD$$

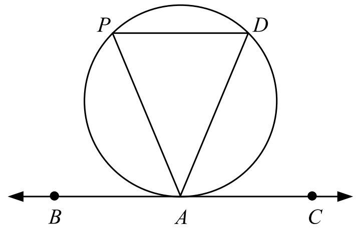



(i) (ii)

> **21.** If $PAB$ is a secant to a circle intersecting the circle at $A$ and $B$ is a tangent segment then $PA \times PB = PT^2$ (refer the figure below).
> (popularly known as Tangent-Secant theorem)




> **22.** Alternate Segment Theorem:
>
> In the figure below, if $BAC$ is the tangent at $A$ to a circle and if $AD$ is any chord, then
>
> $$\angle DAC = \angle APD \text{ and}$$
> $$\angle PAB = \angle PDA$$
>
> (Angles in alternate segment)

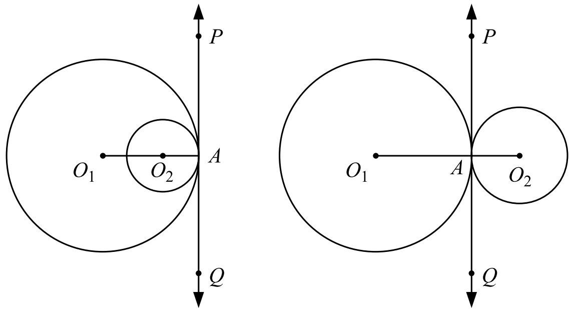



***Note:***

The converse of the above theorem is true.

> **23.** If two circles touch each other internally or externally, the point of contact lies on the line joining their centres.

**Explanation** If two circles with centre $O_1$ and $O_2$ which touch each other internally (i) or externally (ii), at a point $A$ then the point $A$ lies on the line $O_1 O_2$, i.e., three points $A$, $O_1$ and $O_2$ are collinear.

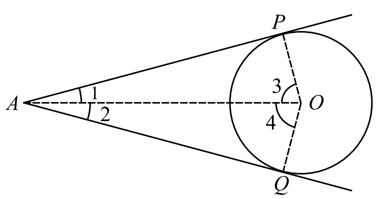



## SOME USEFUL RESULTS

1. There is one and only one circle passing through three non-collinear points.
2. Two circles are congruent if and only if they have equal radii.
3. Of any two chords of a circle, the one which is greater is nearer to the centre.
4. Of any two chords of a circle, the one which is nearer to the centre is greater.
5. If two circles intersect in two points, then the line through the centres is the perpendicular bisector of the common chord.
6. Angle in a major segment of a circle is acute and angle in a minor segment is obtuse.
7. If two tangents are drawn to a circle from an external point then
   (i) they subtend equal angles at the centre.
   (ii) they are equally inclined to the segment, joining the centre to that point.

**Explanation** In a circle $C(O,r)$, A is a point outside it and $AP$ and $AQ$ are the tangents drawn to the circle

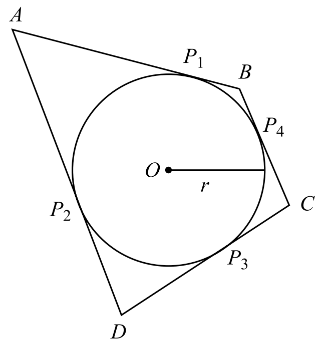
Then, $\angle 1 = \angle 2$ and $\angle 3 = \angle 4$



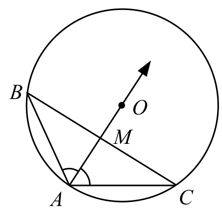

8. If a circle touches all the four sides of a quadrilateral then the sum of opposite pair of sides are equal.

**Explanation** If $ABCD$ is a circumscribed quadrilateral.

Then, $AB + CD = AD + BC$

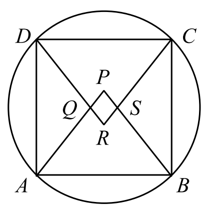



9. If two chords $AB$ and $AC$ of a circle are equal, then the bisector of $\angle BAC$ passes through the centre $O$ of the circle.



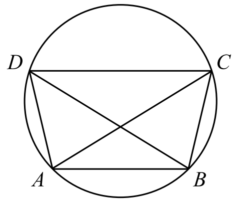

10. The quadrilateral formed by angle bisectors of a cyclic quadrilateral is also cyclic.

**Explanation** If $ABCD$ is a cyclic quadrilateral in which $AP$, $BP$, $CR$ and $DR$ are the bisectors of $\angle A$, $\angle B$, $\angle C$ and $\angle D$, respectively, then quadrilateral $PQRS$ is also cyclic.




11. A cyclic trapezium is isoceles and its diagonals are equal.

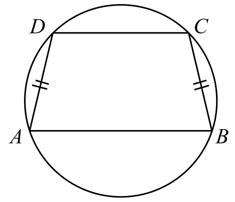
**Explanation** If $ABC$ cyclic trapezium such that $AB \parallel DC$, then $AD = BC$ and $AC = BD$




**12.** If two opposite sides of a cyclic quadrilateral are equal, then the other two sides are parallel.

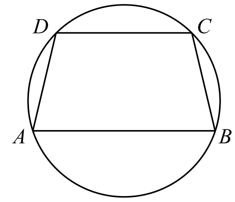
**Explanation** A cyclic quadrilateral $ABCD$ in which $AD = BC$

Then, $AB \parallel CD$




**13.** An isoceles trapezium is always cyclic.

**Explanation** A trapezium $ABCD$ in which $AB \parallel CD$ and $AD = BC$




Then $ABCD$ is a cyclic trapezium.

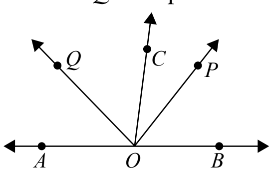
**14.** Any four vertices of a regular pentagon are *concyclic* (lie on the same circle).

## Exercise-I

1. An angle is equal to one-third of its supplement. Its measure is equal to:
   (a) 40° (b) 50°
   (c) 45° (d) 55°

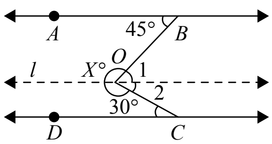
2. The complement of 30°20′ is:
   (a) 69°40′ (b) 59°40′
   (c) 35°80′ (d) 159°40′

3. In the given figure, $OP$ bisect $\angle BOC$ and $OQ$ bisects $\angle AOC$. Then $\angle POQ$ is equal to:



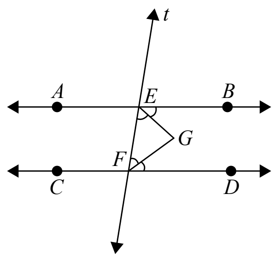

   (a) 90° (b) 120°
   (c) 60° (d) 100°

4. In the given, $AB \parallel CD$. Then $X$ is equal to:



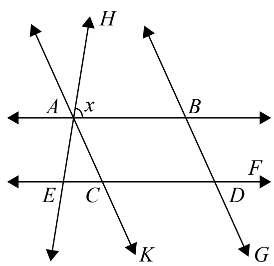

   (a) 290° (b) 300°
   (c) 280° (d) 285°

5. In the adjoining figure, $AB \parallel CD$, t is the transversal, $EG$ and $FG$ are the bisectors of $\angle BEE$ and $\angle DFE$ respectively, then $\angle EGF$ is equal to:




   (a) 90° (b) 75°
   (c) 80° (d) 110°

6. In the given figure, $AB \parallel CD$ and $AC \parallel BD$. If $\angle EAC = 40°$, $\angle FDG = 55°$, $\angle HAB = x$; then the value of $x$ is:

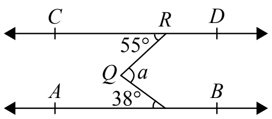


(a) 95° (b) 70°
(c) 35° (d) 85°

**7.** Find the measure of an angle, if six times its complement is 12° less than twice its supplement:
(a) 48° (b) 96°
(c) 24° (d) 58°

**8.** If two parallel lines are intersected by a transversal, then the bisectors of the two pairs of interior angles enclose a:
(a) Trapezium (b) Rectangle
(c) Square (d) none of these

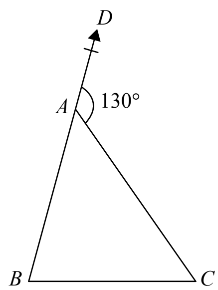
**9.** In fig., $AB \parallel CD$, $\angle a$ is equal to:




(a) 93° (b) 103°
(c) 83° (d) 97°

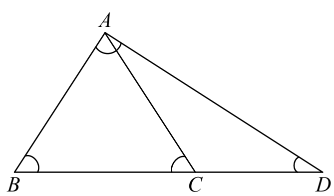
**10.** The complement of an angle exceeds the angle by 60°. Then the angle is equal to:
(a) 25° (b) 30°
(c) 15° (d) 35°

**11.** In the following figure, $\angle B{:}\angle C = 2 : 3$, find $\angle B + \angle C$.




(a) 120° (b) 52°
(c) 78° (d) 130°

**12.** In the given figure, $\angle B = \angle C = 55°$ and $\angle D = 25°$. Then:

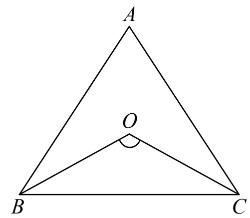



(a) $BC < CA < CD$
(b) $BC > CA > CA$
(c) $BC < CA, CA > CD$
(d) $BC > CA, CA < CD$

**13.** In a $\Delta ABC$, if $2\angle A = 3\angle B = 6\angle C$, Then $\angle A$ is equal to:
(a) 60° (b) 30°
(c) 90° (d) 120°

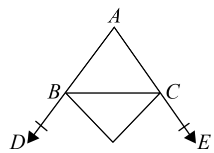
**14.** $A$, $B$, $C$ are the three angles of a $\Delta$. If $A - B = 15°$ and $B - C = 30°$. Then $\angle A$ is equal to:
(a) 65° (b) 80°
(c) 75° (d) 85°

**15.** In $\Delta ABC$, the angle bisectors of $\angle B$ and $\angle C$ meet at $O$. If $\angle A = 70°$, then $\angle BOC$ is equal to:



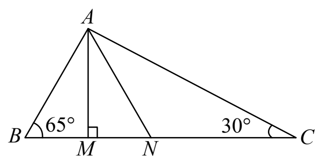

(a) 135° (b) 125°
(c) 115° (d) 110°

**16.** The sides $AB$ and $AC$ of $\Delta ABC$ have been produced to $D$ and $E$ respectively. The bisectors of $\angle CBD$ and $\angle BCE$ meet at $O$. If $\angle A = 40°$, then $\angle BOC$ is equal to:

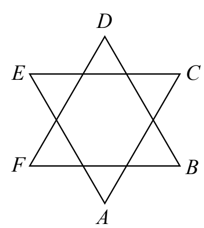



(a) 60° (b) 65°
(c) 75° (d) 70°

**17.** In the given figure, $AM \perp BC$ and $AN$ is the bisector of $\angle A$. What is the measure of $\angle MAN$.
(a) 17.5° (b) 15.5°
(c) 20° (d) 25°

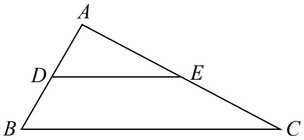



**18.** In the adjoining figure $\angle A + \angle B + \angle C + \angle D + \angle E + \angle F =$



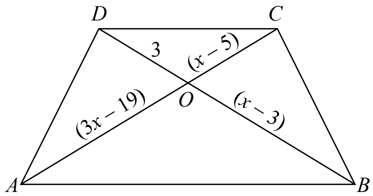
(a) 270° (b) 300°
(c) 360° (d) 330°

**19.** In the given figure, $DE \parallel BC$ if $AD = 1.7$ cm, $AB = 6.8$ cm and $AC = 9$ cm, find $AE$.




(a) 2.25 cm (b) 4.5 cm
(c) 1.25 cm (d) 2.5 cm

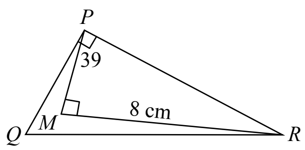
**20.** In the given figure, $AB \parallel DC$, find the value of $x$.




(a) $x = 8$ (b) $x = 9$
(c) $x = 8$ or 9 (d) $x = 10$

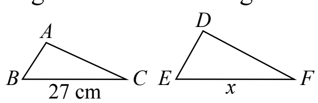
**21.** If the bisector of an angle of Δ bisects the opposite side, then the Δ is:
(a) Scalene (b) Isosceles
(c) Right triangle (d) None of these

**22.** In the given figure $\angle QPR = 90°$, $QR = 26$ cm, $PM = 6$ cm, $MR = 8$ cm and $\angle PMR = 90°$, find the area of $\Delta PQR$.



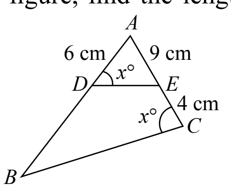

(a) 180 $cm^2$ (b) 240 $cm^2$
(c) 120 $cm^2$ (d) 150 $cm^2$

**23.** The areas of two similar Δs are 81 $cm^2$ and 144 $cm^2$. If the largest side of the smaller Δ is 27 cm, then the largest side of the larger Δ is:



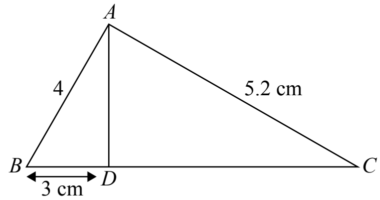

(a) 24 cm (b) 48 cm
(c) 36 cm (d) None of these

**24.** In the given figure, find the length of $BD$.




(a) 13.5 cm (b) 12 cm
(c) 14.5 cm (d) 15 cm

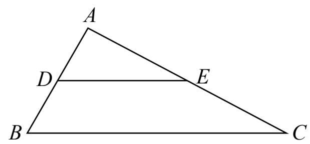
**25.** In the given figure $\angle BAD = \angle CAD$. $AB = 4$ cm, $AC = 5.2$ cm, $BD = 3$ cm. Find $BC$.




(a) 6.9 cm (b) 9.6 cm
(c) 3.9 cm (d) 9.3 cm

**26.** A ladder 15 m long reaches a window which is 9 m above the ground on one side of street. Keeping its foot at the same point, the ladder is turned to the other side of the street to reach a window 12 m high. What is the width of the street:
(a) 31 m (b) 12 m
(c) 30 m (d) 21 m

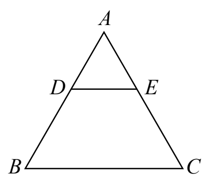
**27.** In, $\Delta ABC$, $D$ and $E$ are the mid-points of $AB$ and $AC$ respectively. Find the ratio of the areas of $\Delta ADE$ and $\Delta ABC$.




(a) $\frac{1}{2}$ (b) $\frac{1}{4}$
(c) $\frac{3}{4}$ (d) $\frac{1}{8}$

**28.** A vertical stick 12 cm long casts a shadow 8 cm long on the ground. At the same time a tower casts the shadow 40 m long on the ground. Find the height of the tower.
(a) 600 m (b) 160 m
(c) 60 m (d) 52 m

**29.** $D$ and $E$ are the points on the sides $AB$ and $AC$ respectively of $\Delta ABC$ such that $AD = 8$ cm, $BD = 12$ cm, $AE = 6$ cm and $EC = 9$ cm. Then find $BC/DE$.



(a) $\frac{5}{2}$ (b) $\frac{2}{5}$

(c) $\frac{5}{7}$ (d) $\frac{5}{3}$

**30.** In an equilateral $\Delta ABC$, if $AD \perp BC$, then:
(a) $3AB^2 = 2AD^2$ (b) $2AB^2 = 3AD^2$
(c) $3AB^2 = 4AD^2$ (d) $4AB^2 = 3AD^2$

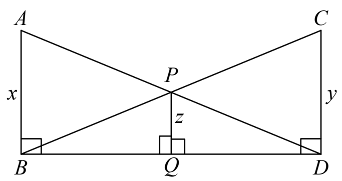
**31.** In a right angled $\Delta ABC$, rt. angled at $A$, $AD \perp BC$. Then:
(a) $AD^2 = BD \times CD$ (b) $AD^2 = AB \times AC$
(c) $AD^2 = BD \times AB$ (d) $AD^2 = CD \times AC$

**32.** If $ABCD$ is a ||gm and $AC$ and $BD$ be its diagonals, then:
(a) $AB^2 + BC^2 + CD^2 + DA^2 = AC^2 - BD^2$
(b) $AB^2 + BC^2 + CD^2 + DA^2 = AC^2 + BD^2$
(c) $4AD^2 = 2AC^2 + 2BD^2$
(d) $4AB^2 = 2AC^2 - 2BC^2$

**33.** In the given figure, $\angle ABD = \angle CBD = \angle PQB = 90°$. Then:

(a) $\frac{1}{x} - \frac{1}{y} = \frac{1}{z}$ (b) $\frac{1}{x} + \frac{1}{z} = \frac{1}{y}$

(c) $\frac{1}{x} + \frac{1}{y} = \frac{1}{z}$ (d) $\frac{1}{y} - \frac{1}{x} = \frac{1}{z}$

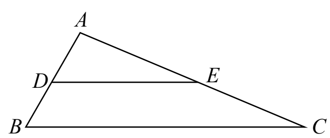



**34.** The area of two similar Δs are 121 cm$^2$ and 81 cm$^2$ respectively. What is the ratio of their corresponding heights (altitudes):

(a) $\frac{11}{9}$ (b) $\frac{22}{9}$

(c) $\frac{11}{18}$ (d) None of these

**35.** In the given figure, $DE \parallel BC$ and $DE : BC = 3{:}5$ the ratio of the areas of $\Delta ADE$ and the trapezium $BCED$.




(a) $\frac{9}{25}$ (b) $\frac{12}{25}$

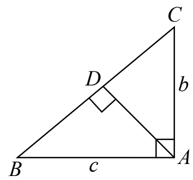
(c) $\frac{3}{4}$ (d) $\frac{9}{16}$

**36.** In a ΔABC, AD intersects ∠A and BC. If $BC = a$, $AC = b$ and $AB = c$, Then:

(a) $CD = \frac{b+c}{ab}$ (b) $CD = \frac{ab}{b+c}$

(c) $CD = \frac{bc+ab}{ac}$ (d) $CD = \frac{ac}{bc+ab}$

**37.** In the given figure, what is the length of $AD$ in terms of $b$ and $c$:




(a) $\frac{bc}{b^2+c^2}$ (b) $\frac{b^2+c^2}{bc}$

(c) $\frac{\sqrt{b^2+c^2}}{bc}$ (d) $\frac{bc}{\sqrt{b^2+c^2}}$

**38.** $ABC$ is a Δ in which $AB = AC$ and $D$ is a point on $AC$ such that $BC^2 = AC \times CD$. Then:
(a) $BD = DC$ (b) $BD = BC$
(c) $BD = AB$ (d) $BD = AD$

**39.** Two poles of ht. $a$ and $b$ metres are $p$ metres apart ($b > a$). The height of the point of intersection of the lines joining the top of each pole to the foot of the opposite pole is:

(a) $\frac{a+b}{ab}$ (b) $\frac{p}{a+b}$

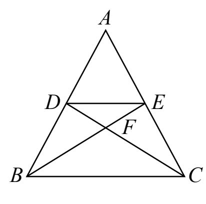
(c) $\frac{ab}{a+b}$ (d) $\frac{a+b}{p}$

**40.** $ABC$ is a right Δ, right-angled at $C$. If $AB = c$, $BC = a$ and $CA = b$ and $p$ is the length of the perpendicular from $C$ on $AB$. Then:

(a) $\frac{1}{p^2} + \frac{1}{a^2} = \frac{1}{b^2}$ (b) $\frac{1}{p^2} + \frac{1}{b^2} = \frac{1}{a^2}$

(c) $\frac{1}{a^2} = \frac{1}{b^2} + \frac{1}{p^2}$ (d) $\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2}$

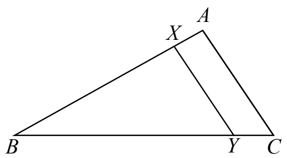
**41.** In the given figure $DE \| BC$ and $AD : DB = 5{:}4$, Then $\frac{ar(\Delta DFE)}{ar(\Delta CFB)}$



(a) $\frac{25}{81}$ (b) $\frac{25}{16}$

(c) $\frac{16}{25}$ (d) $\frac{16}{81}$

**42.** In the fig. $XY \parallel AC$ and $XY$ divides triangular region $ABC$ into two part equal in area. Then $\frac{AX}{AB}$ is equal to:



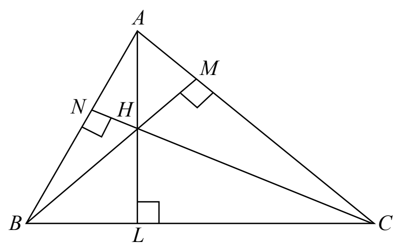

(a) $\frac{1}{\sqrt{2}}$ (b) $\frac{\sqrt{2}+2}{\sqrt{2}}$

(c) $\frac{1}{2}$ (d) $\frac{\sqrt{2}-1}{\sqrt{2}}$

**43.** A point $O$ in the interior of a rectangular $ABCD$ is joined with each of the vertices $A$, $B$, $C$ and $D$. Then:
(a) $OA^2 + OC^2 = OB^2 - OD^2$
(b) $OA^2 + OC^2 = OB^2 + OD^2$
(c) $OA^2 = OB^2 = OC^2 + OD^2$
(d) $OA^2 + OD^2 = OB^2 + OC^2$

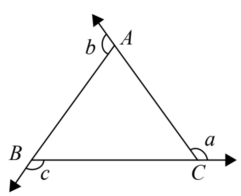
**44.** In $\Delta ABC$, the median $BE$ intersects $AC$ at $E$, if $BG$ = 6 cm, where $G$ is the centroid, then $BE$ is equal to:
(a) 7 cm (b) 9 cm
(c) 8 cm (d) 10 cm

**45.** If $H$ is the orthocentre of $\Delta ABC$, then the orthocentre of $\Delta HBC$ is (fig. given):




(a) $N$ (b) $M$
(c) $A$ (d) $L$

**46.** If the sides of a triangle are produced then the sum of the exterior angles i.e., $\angle a + \angle b + \angle c$ is equal to:




(a) 180° (b) 90°
(c) 360° (d) 270°

**47.** Incentre of a triangle lies in the interior of:
(a) an isosceles triangle only
(b) any triangle
(c) an equilateral triangle only
(d) a right triangle only

**48.** In a $\Delta ABC$, the bisectors of $\angle B$ and $\angle C$ *intersect* each other at apoint $O$. Then $\angle BOC$ is equal to:

(a) $90° - \frac{1}{2}\angle A$ (b) $120° + \frac{1}{2}\angle A$

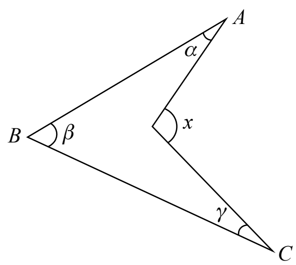
(c) $90° + \frac{1}{2}\angle A$ (d) $120° - \frac{1}{2}\angle A$

**49.** In a $\Delta ABC$, the sides $AB$ and $AC$ are produced to $P$ and $Q$ respectively. The bisectors of $\angle OBC$ and $\angle QCB$ intersect at a point $O$. Then $\angle BOC$ is equal to:

(a) $90° + \frac{1}{2}\angle A$ (b) $90° - \frac{1}{2}\angle A$

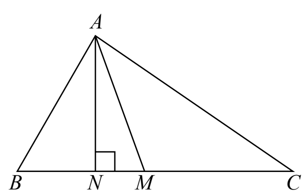
(c) $120° + \frac{1}{2}\angle A$ (d) $120° - \frac{1}{2}\angle A$

**50.** In the given figure, which of the following is true:




(a) $x = \alpha + \beta + \gamma$ (b) $x + \beta = \alpha + \gamma$
(c) $x + \gamma = \beta + \alpha$ (d) $x + \alpha = \beta + \gamma$

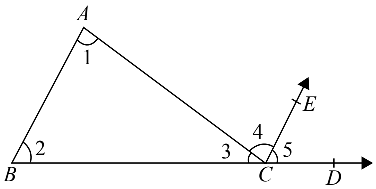
**51.** In the given figure, In a $\Delta ABC$, $\angle B = \angle C$. If $AM$ is the bisector of $\angle BAC$ and $AN \perp BC$, then $\angle MAN$ is equal to:




(a) $\frac{1}{2}(\angle B + \angle C)$ (b) $\frac{1}{2}(\angle C - \angle B)$

(c) $\angle B + \angle C$ (d) $\frac{1}{2}(\angle B - \angle C)$

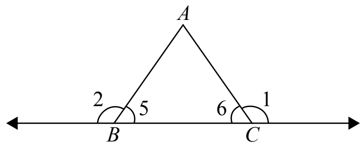
**52.** In the given figure, side $BC$ of $\Delta ABC$ is produced to form ray $BD$ and $CE \parallel BA$. Then $\angle ACD$ is equal to:




(a) $\angle A - \angle B$ (b) $\frac{1}{2}(\angle A + \angle B)$

(c) $\angle A + \angle B$ (d) $\frac{1}{2}(\angle A - \angle B)$

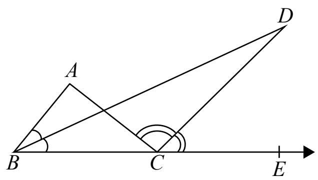
**53.** In the given figure, the side $BC$ of a $\Delta ABC$ is produced on both sides. Then $\angle 1 + \angle 2$ is equal to:




(a) $\angle A + 180°$ (b) $180° - \angle A$

(c) $\frac{1}{2}(\angle A + 180°)$ (d) $\angle A + 90°$

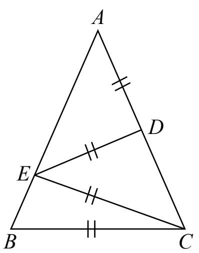
**54.** In the figure, $BD$ and $CD$ are angle bisectors of $\angle ABC$ and $\angle ACE$, respectively. Then $\angle BDC$ is equal to:




(a) $\angle BAC$ (b) $2\angle BAC$

(c) $\frac{1}{2}\angle BAC$ (d) $\frac{1}{3}\angle BAC$

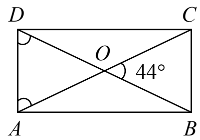
**55.** In fig, $AB = AC$, $D$ is a point on $AC$ and $E$ on $AB$ such that $AD = ED = EC = BC$. Then $\angle A{:}\angle B$:




(a) 1:2 (b) 2:1

(c) 3:1 (d) 1:3

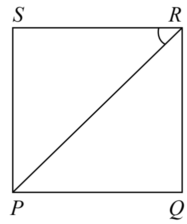
**56.** The diagonals of a rectangle $ABCD$ meet at 0. If $\angle BOC = 44°$, then $\angle OAD$ is equal to:




(a) 90° (b) 60°

(c) 100° (d) 68°

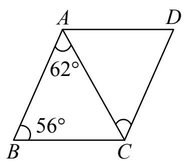
**57.** $PQRS$ is a square. The $\angle SRP$ is equal to:




(a) 45° (b) 90°

(c) 100° (d) 60°

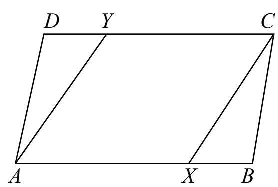
**58.** $ABCD$ is a rhombus with $\angle ABC = 56°$, then $\angle ACD$ is equal to:




(a) 90° (b) 60°

(c) 56° (d) 62°

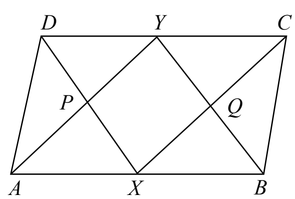
**59.** $ABCD$ is a parallelogram and $X$, $Y$ are the mid-points of sides $AB$ and $CD$ respectively. Then quadrilateral $AXCY$ is a:




(a) parallelogram (b) rhombus

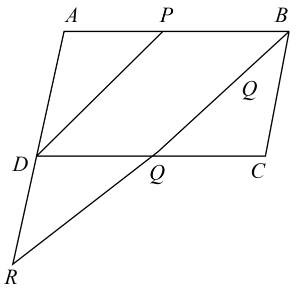
(c) square (d) rectangle

**60.** $X$, $Y$ are the mid-points of opposite sides $AB$ and $DC$ of a parallelogram $ABCD$. $AY$ and $DX$ are joined intersecting in $P$; $CX$ and $BY$ are joined intersecting in $Q$. Then $PXQY$ is a:



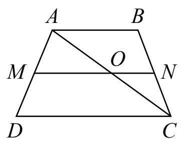
(a) Rectangle (b) Rhombus
(c) Parallelogram (d) Square

**61.** $P$ is the mid-point of side $AB$ to a parallelogram $ABCD$. A line through $B$ parallel to $PD$ meets $DC$ at $Q$ and $AD$ produced at $R$. Then $BR$ is equal to:



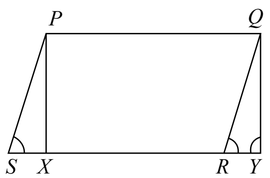

(a) $BQ$ (b) $\frac{1}{2}$
(c) $2BQ$ (d) None of these

**62.** $ABCD$ is a trapezium in which $AB \parallel CD$. $M$ and $N$ are the mid-points of $AD$ and respectively. If $AB$ = 12 cm an $MN$ = 14 cm. Find $CD$.



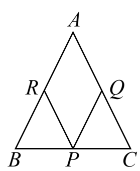

(a) 2 cm (b) 5 cm
(c) 12 cm (d) 16 cm

**63.** $PQRS$ is a parallelogram. $PX$ and $QY$ are, respectively, the perpendicular form $P$ and $Q$ to $SR$ and $SR$ produced. The $PX$ is equal to:



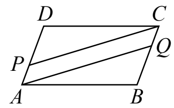

(a) $QY$ (b) $2QY$
(c) $\frac{1}{2}Q$ (d) $XR$

**64.** In a $\Delta ABC$, $P$, $Q$ and $R$ are the mid-points of sides $BC$, $CA$ and $AB$ respectively. If $AC$ = 21 cm, $BC$ = 29 cm and $AB$ = 30 cm. The perimeter of the quad. $ARPQ$ is:



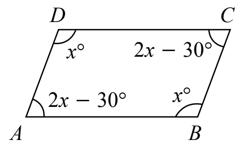

(a) 91 cm (b) 60 cm
(c) 51 cm (d) 70 cm

**65.** $ABCD$ is a parallelogram. $P$ is a point on $AD$ such that $AP = \frac{1}{3}AD$ and $Q$ is a point on $BC$ such that $CQ = \frac{1}{3}BC$. Then $AQCP$ is a:



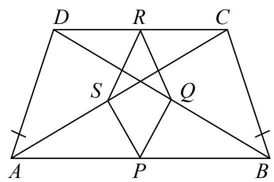

(a) Parallelogram (b) Rhombus
(c) Rectangle (d) Square

**66.** Find the measure of each angle of a parallelogram, if one of its angles is 30° less than twice the smallest angle.



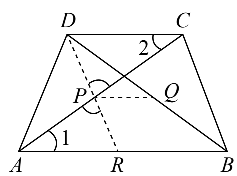

(a) 60°, 100°, 90°, 20°
(b) 80°, 40°, 120°, 90°
(c) 100°, 90°, 90°, 80°
(d) 70°, 110°, 70°, 110°

**67.** $ABCD$ is a trapezium in which $AB \parallel DC$ and $AD$ = $BC$. If $P$, $Q$, $R$, $S$ be respectively the mid-point of $BA$, $BD$ and $CD$, $CA$. The $PQRS$ is a:



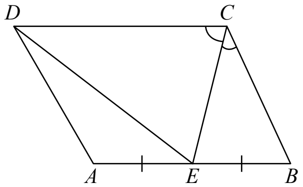

(a) Rhombus (b) Rectangle
(c) Parallelogram (d) Square

**68.** $ABCD$ is a trapezium and $P$, $Q$ are the mid-points of the diagonals $AC$ and $BD$. Then $PQ$ is equal to:




(a) $\frac{1}{2}(AB)$ (b) $\frac{1}{2}(CD)$
(c) $\frac{1}{2}(AB-CD)$ (d) $\frac{1}{2}(AB+CD)$

**69.** *ABCD* is a parallelogram, E is the mid-point of *AB* and *CE* bisects $\angle BCD$. The $\angle DEC$ is:




(a) 60° (b) 90°
(c) 100° (d) 120°

**70.** The angles of a quadrilateral are respectively 100°, 98° and 92°. The fourth angle is equal to:
(a) 90° (b) 95°
(c) 70° (d) 75°

**71.** The measure of each angle of a regular hexagon is:
(a) 110° (b) 130°
(c) 115° (d) 120°

**72.** The interior angle of a regular polygon is 108°. The number of sides of the polygon is:
(a) 6 (b) 7
(c) 8 (d) 5

**73.** The number of diagonals in a hexagon is:
(a) 9 (b) 8
(c) 10 (d) 7

**74.** If the number of diagonals of a polygon is 27, then the number of sides is:
(a) 10 (b) 9
(c) 11 (d) 6

**75.** One angle of a pentagon is 140°. If the remaining angles are in the ratio 1:2:3:4. The size of the greatest angle is:
(a) 150° (b) 180°
(c) 160° (d) 170°

**76.** The exterior angle of a regular polygon is $\frac{1}{3}$ of its interior angle. The number of the sides of the polygon is:
(a) 9 (b) 8
(c) 10 (d) 12

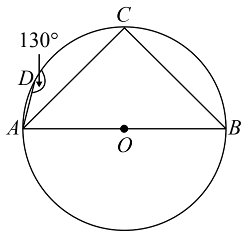
**77.** The ratio of the measure of an angle of a regular octagon to the measure of its exterior angle is:
(a) 3:1 (b) 2:1
(c) 1:3 (d) 1:2

**78.** *ABCDE* is a regular pentagon. Diagonal *AD* divides $\angle CDE$ in to parts, then the ratio of $\frac{\angle ADE}{\angle ADC}$ is equal to:
(a) 3:1 (b) 1:4
(c) 1:3 (d) 1:2

**79.** The difference between an exterior angle of $(n - 1)$ sided regular polygon and an exterior angle of $(n - 2)$ sided regular polygon is 6°, then the value of $n$ is:
(a) 14 (b) 15
(c) 13 (d) 12

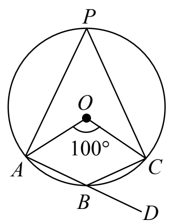
**80.** The radius of a circle is 13 cm and the length of one of its chords is 10 cm. What is the distance of the chord from the centre:
(a) 10 cm (b) 15 cm
(c) 12 cm (d) 9 cm

**81.** In the given figure, *ABCD* is a cyclic quadrilateral whose side *AB* is a diameter of the circle through *A*, *B* and *C*. If $\angle ADC = 130°$, find $\angle CAB$.



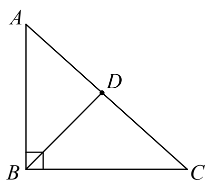

(a) 40° (b) 50°
(c) 30° (d) 130°

**82.** In the given figure, *O* is the centre of the circle, Find $\angle CBD$.




(a) 140° (b) 50°
(c) 40° (d) 130°

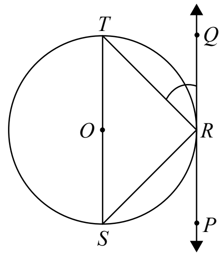
**83.** In a $\Delta ABC$, $\angle$B is a right angle, $AC = 6$ cm and *D* is the mid-point of *AC*. Find the length of *BD*.




(a) 4 cm (b) $\sqrt{6}$ cm
(c) 3 cm (d) 4.5 cm

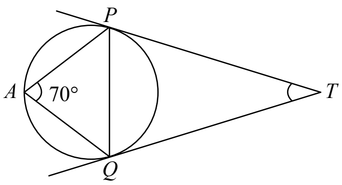
**84.** A cyclic quadirateral whose opposite angles are equal, is a:
(a) Parallelogram but not a rhombus
(b) Rhombus
(c) Rectangle
(d) Square but not a rectangle

**85.** In the given figure, $ST$ is a diameter of the circle with centre $O$ and $PQ$ is the tangent at a point $R$. If $\angle TRQ$ = 40, what is $\angle RTS$:



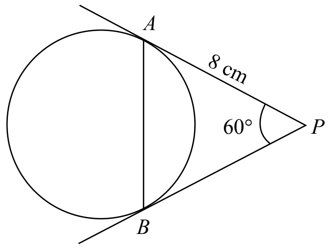

(a) 40° (b) 50°
(c) 60° (d) 30°

**86.** In the given figure, $TP$ and $TQ$ are tangents to the circle. If $\angle PAQ$ = 70°, what is $\angle PTQ$?



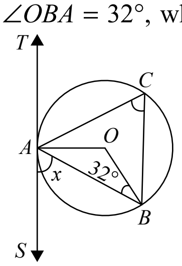

(a) 30° (b) 45°
(c) 60° (d) 40°

**87.** In the given figure, $PA$ and $PB$ are tangents from a point $P$ to a circle such that $PA$ = 8 cm and $\angle APB$ = 60°. What is the length of the chord $AB$?



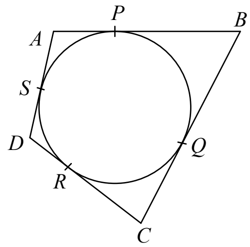

(a) 8 cm (b) 10 cm
(c) 6 cm (d) 12 cm

**88.** In the given figure, $TAS$ is a tangent to the circle at the point $A$. If $\angle OBA$ = 32°, what is the value of $x$:




(a) 64° (b) 40°
(c) 58° (d) 50°

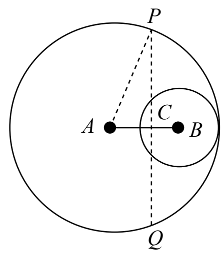
**89.** In the given figure, a circle touches all the four sides of quadrilateral $ABCD$ whose sides $AB$ = 6 cm, $BC$ = 7 cm and $CD$ = 4 cm. Find $AD$.




(a) 5 cm (b) 4 cm
(c) 3 cm (d) 2 cm

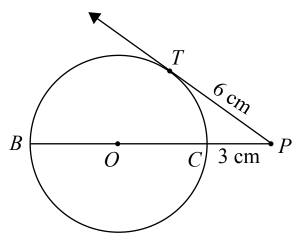
**90.** $AB$ and $CD$ are two parallel chords of a circle such that $AB$ = 10 cm and $CD$ = 24 cm. If the chords are on opposite sides of the centre and the distance between them is 17 cm, what is the radius of the circle:
(a) 14 cm (b) 10 cm
(c) 13 cm (d) 15 cm

**91.** In the given figure, two circle with centres $A$ and $B$ of radii 5 cm and 3 cm touch each other internally. If the perpendicular bisector of segment $AB$ meets the bigger circle in $P$ and $Q$, find the length of $PQ$.



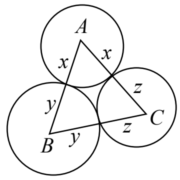

(a) $4\sqrt{6}$ cm (b) $\sqrt{24}$ cm
(c) $8\sqrt{3}$ cm (d) $4\sqrt{3}$ cm

**92.** In the given figure $O$ is the centre of the circle and $PT$ is a tangent at $T$. If $PC$ = 3cm, $PT$ = 6 cm, calculate the radius of the circle.



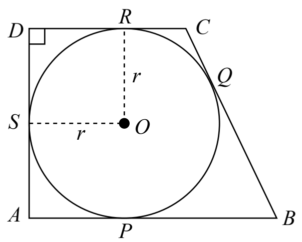

(a) 9 cm (b) 4.5 cm
(c) 8 cm (d) 12 cm

**93.** With the vertices of a $\Delta ABC$ as centres, three circles are described, each touching the other two externally. If the sides of the $\Delta$ are 9 cm, 7 cm and 6 cm, find the radii of the circles:



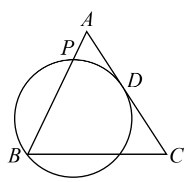

(a) 4cm, 7cm and 3cm
(b) 7cm, 5cm and 2cm
(c) 5cm, 4cm and 3cm
(d) 4cm, 5cm and 2cm

**94.** In the given figure, $ABCD$ is a quadrilateral in which $\angle O = 90$. A circle $C(0, r)$ touches the sides $AB$, $BC$, $CD$ and $DA$ at $P$, $Q$, $R$, $S$ respectively. If $BC = 38$ cm, $CD = 25$ cm and $BP = 27$ cm, find the value of $r$.




(a) 14 cm (b) 15 cm
(c) 10 cm (d) 16 cm

**95.** In the given figure, $ABC$ is an isosceles $\Delta$ in which $AB = AC$. A circle through $B$ touches $AC$ at its mid-point $D$ and intersects $AB$ at $P$. Then which of the following is correct:

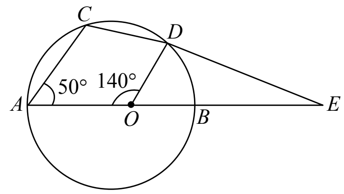



(a) $AP = \frac{3}{4}AB$ (b) $AP = \frac{2.5}{3}AB$
(c) $AP = \frac{4}{5}AB$ (d) $AP = \frac{1}{4}AB$

**96.** $ABC$ is a right angled $\Delta$ with $BC = 6$ cm and $AB = 8$ cm. A circle with centre $O$ is inscribed in $\Delta ABC$. The radius of the circle is:
(a) 4 cm (b) 3 cm
(c) 2 cm (d) 1 cm

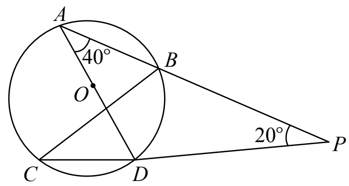
**97.** If all the sides of a parallelogram touch a circle, then the parallelogram is a:
(a) Rectangle (b) Rhombus
(c) Square (d) None

**98.** In the given figure, $O$ is the centre of a circle. If $\angle AOD = 140°$ and $\angle CAB = 50°$, what is $\angle EDB$:




(a) 70° (b) 40°
(c) 60° (d) 50°

**99.** $PBA$ and $PDC$ are two secants. $AD$ is the diameter of the circle with centre at $O$. $\angle A = 40$, $\angle P = 20°$. Find the measure of $\angle DBC$.

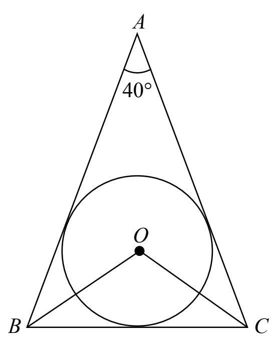



(a) 30° (b) 45°
(c) 50° (d) 40°

**100.** In the given figure, $O$ is the centre of the circle. Then $\angle x + \angle y$ is equal to:
(a) $2\angle z$ (b) $\frac{\angle z}{2}$
(c) $\angle z$ (d) None

**101.** In a circle of radius 5 cm, $AB$ and $AC$ are two equal chords such that $AB = AC = 6$ cm. What is the length of the chord $BC$.
(a) 9.6 cm (b) 11 cm
(c) 12 cm (d) 9 cm

**102.** In the given figure $O$ is the centre of incircle for $\Delta ABC$. Find $\angle BOC$ if $\angle BAC = 40°$.




(a) 100° (b) 120°
(c) 90° (d) 110°

**103.** If an equilateral triangle $ABC$ be inscribed in a circle, then the tangents at their vertices will form another Δ.

(a) scalene (b) equilateral
(c) Isosceles (d) Right Δ

**104.** The radius of the incircle of a Δ is 4 cm and the segments into which one side is divided by the point of contact are 6 cm and 8 cm, then the length of the shortest side of the Δ is:

(a) 12 cm (b) 15 cm
(c) 13 cm (d) 14 cm

## EXERCISE-2
## (BASED ON MEMORY)

**1.** The two sides of a right triangle containing the right angle measure 3cm and 4cm. The radius of the incircle of the triangle is:

(a) 3.5 cm (b) 1.75 cm
(c) 1 cm (d) 0.875 cm

**2.** If two diameters of a circle intersect each other at right angles, then the quadrilateral formed by joining here end points is a:

(a) Rhombus (b) Rectangle
(c) Square (d) Parallelogram

**3.** Of all the chords of a circle passing through a given point in it, the smallest is that which:

(a) Is trisected at the point
(b) Is bisected at the point
(c) Passes through the centre
(d) None of these

**4.** In a circular lawn, there is a 16 m long path in the form of a chord. If the path is 6 m away from the centre of the lawn, then find the radius of the circular lawn.

(a) 16 m (b) 6 m
(c) 10 m (d) 8 m

**5.** The number of tangents that can be drawn to two non-intersecting circles:

(a) 4 (b) 3
(c) 2 (d) 13

**6.** In a triangle $ABC$, the length of the sides $AB$, $AC$ and $BC$ are 3, 5 and 6 cm respectively. If a point $D$ on $BC$ is drawn such that the line $AD$ bisects the angle $A$ internally, then what is the length of $BD$?

(a) 2 cm (b) 2.25 cm
(c) 2.5 cm (d) 3 cm

**7.** In a triangle ABC, $\angle A = x°$, $\angle B = y°$ and $\angle C = (y + 20)°$. If $4x - y = 10$, then the triangle is:

(a) Right-angle (b) Obtuse-angled
(c) Equilateral (d) None of these

**8.** If the sides of a right triangle are $x$, $x + 1$ and $x - 1$, then the hypotenuse:

(a) 5 (b) 4
(c) 1 (d) 0

**9.** If one of the diagonals of a rhombus is equal to its side, then the diagonals of the rhombus are in the ratio:

(a) $\sqrt{3}:1$ (b) $\sqrt{2}:1$
(c) 3:1 (d) 2:1

**10.** If $P$ and $Q$ are the mid points of the sides $CA$ and $GB$ respectively of a triangle $ABC$, right-angled at $C$. Then the value of $4(AQ^2 + BP^2)$ is equal to:

(a) $4\ BC^2$ (b) $5\ AB^2$
(c) $2\ AC^2$ (d) $2\ BC^2$

**11.** In a quadrilateral $ABCD$, $\angle B = 90°$ and $AD^2 = AB^2 + BC^2 + CD^2$, then $\angle ACD$ is equal to:

(a) 90° (b) 60°
(c) 30° (d) None of these

**12.** $ABCD$ is a square, $F$ is mid point of $AB$ and $E$ is a point on $BC$ such that $BE$ is one-third of $BC$. If area of $\Delta FBE = 108\ m^2$, then the length of $AC$ is:

(a) 63 m (b) $36\sqrt{2}$ m
(c) $63\sqrt{2}$ m (d) $72\sqrt{2}$ m

**13.** We have an angle of $2\frac{1}{2}^{\circ}$. How big it will look through a glass that magnifies things three times?

(a) $2\frac{1}{2}^{\circ} \times 4$ (b) $2\frac{1}{2}^{\circ} \times 3$
(c) $2\frac{1}{2}^{\circ} \times 2$ (d) None of these

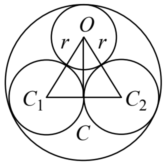
**14.** Two circles with radii '$a$' and '$b$' respectively touch each other externally. Let '$c$' be the radius of a circle

that touches these two circle as well as a common tagent to the two circles. Then:

(a) $\frac{1}{\sqrt{a}} - \frac{1}{\sqrt{b}} = \frac{1}{\sqrt{c}}$ (b) $\frac{1}{\sqrt{a}} - \frac{1}{\sqrt{b}} = \frac{1}{\sqrt{c}}$

(c) $\frac{1}{\sqrt{a}} + \frac{1}{\sqrt{b}} = \frac{1}{\sqrt{c}}$ (d) None of these

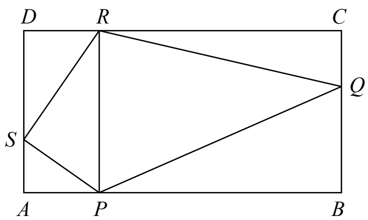
**15.** Two circles of unit radius touch each other and each of them touches internally a circle of radius two, as shown in the following figure. The radius of the circle which thouches all the three circles:




(a) 5 (b) $\frac{3}{2}$

(c) $\frac{2}{3}$ (d) None of these

**16.** *ABCD* is a parallelogram *P*, *Q*, *R* and *S* are points on sides *AB*, *BC*, *CD* and *DA* respectively such that *AP* = *DR*. If the area of the parallelogram *ABCD* is 16 cm$^2$, then the area of the quadrilateral *PQRS* is:

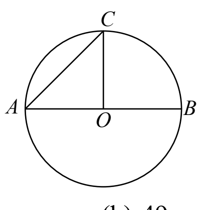



(a) 6 cm$^2$ (b) 6.4 cm$^2$
(c) 4 cm$^2$ (d) 8 cm$^2$

**17.** Let *ABC* be an acute-angled triangle and *CD* be the altitude through *C*. If *AB* = 8 and *CD* = 6, then the distance between the mid-points of *AD* and *BC* is:

(a) 36 (b) 25
(c) 27 (d) 5

**18.** In the accompanying figure, *AB* is one of the diameters of the circle and *OC* is perpendicular to it through the centre *O*. If *AC* is $7\sqrt{2}$ cm, then what is the area of the circle in cm$^2$?

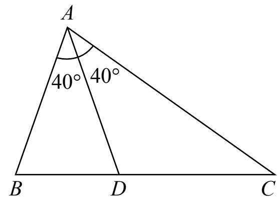



(a) 24.5 (b) 49
(c) 98 (d) 154

**19.** The circumcentre of a triangle is always the point of intersection of the:

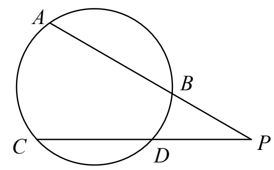
(a) Medians
(b) Bisectors
(c) Perpendiculars
(d) Perpendiculars dropped from the, vertices on the opposite side of the triangle

**20.** In the following figure, If *BC* = 8 cm, *AB* = 6 cm, *AC* 9 cm, then *DC* is equal to:




(a) 7 cm (b) 4.8 cm
(c) 7.2 cm (d) 4.5cm

**21.** If, in the following figure, *PA* = 8 cm, *PD* = 4 cm, *CD* equal to 3 cm, then *AB* is:




(a) 3.0 cm (b) 3.5 cm
(c) 4.0 cm (d) 4.5 cm

**22.** The number of tangents that can be drawn to two non-intersecting circle is:

(a) 4 (b) 3
(c) 2 (d) 1

**23.** With the vertices of a $\Delta ABC$ as centers, three circles are described each touching the other two externally. If the sides of the triangle are 4, 6 and 8 cm respectively, then the sum of the radii of the three circles equals:

(a) 10 (b) 14
(c) 12 (d) 9

**24.** If 6440 soldiers were asked to stand in rows to from a perfect square, it was found that 40 soldiers were left out. What was the number of soldiers in each row?

(a) 40 (b) 80
(c) 64 (d) 60

**25.** The perimeters of two similar triangles *ABC* and *PQR* and 36 cm and 24 cm respectively. If *PQ* = 10 cm, the length of *AB* is:

(a) 16 cm (b) 12 cm
(c) 14 cm (d) 15 cm

**26.** If an angle is its own complementary angle, then its measure is:

(a) 30 (b) 45
(c) 60 (d) 90

**27.** The sum of the interior angles of a polygon is 1620°. The number of sides of the polygon are

(a) 9 (b) 11
(c) 15 (d) 12

**28.** How many sides a regular polygon has with its interior angle eight times its exterior angle?

(a) 16 (b) 24
(c) 18 (d) 20

**29.** The intercepts made by three parallel lines on a transverse line ($l_1$) are in the ratio 1:1. A second transverse line ($l_2$) making an angle of 30° with ($l_1$) is drawn. The corresponding intercepts on ($l_2$) are in the ratio:

(a) 1:1 (b) 2:1
(c) 1:2 (d) 1:3

**30.** The ratio of the sides of two regular polygons is 1:2 and of their interior angles, 3:4. The number of sides in each polygon is:

(a) 5, 10 (b) 10, 5
(c) 6, 8 (d) 9, 12

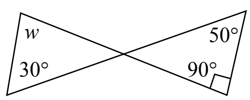
**31.** The degree measure of each of the three angles of a triangle is an integer. Which of the following could NOT be the ratio of their measures?

(a) 2:3:4 (b) 3:4:5
(c) 5:6:7 (d) 6:7:8

**32.** Three lines are drawn in a plane. Which of the following could NOT be the total number of points of intersection?

(a) 0
(b) 1
(c) 2
(d) All of the above could be the total number of points of intersection

**33.** In the figure given below, what is the value of $w$?

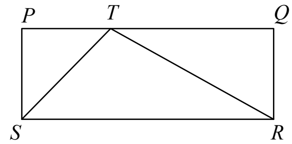



(a) 100 (b) 110
(c) 120 (d) 130

*Note:*

The diagram is not drawn to scale.

**34.** In the figure below, what is the ratio of the area of the triangle *STR* to the area of the rectangle *PQRS*?

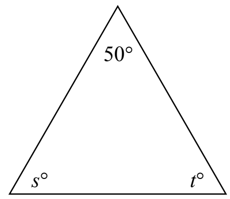



(a) 1:4 (b) 1:3
(c) 1:2 (d) 2:1

*Note:*

The diagram is not drawn to scale.

**35.** In the figure above, if $s < 50° < t$, then:




(a) $t < 80$ (b) $s + t < 130$
(c) $50 < t < 80$ (d) $t > 80$

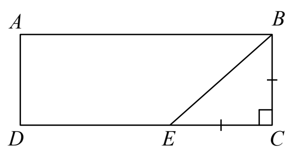
*Note:*

The diagram is not drawn to scale

**36.** The radius of the circumcircle of an equilateral triangle of side 12 cm is:

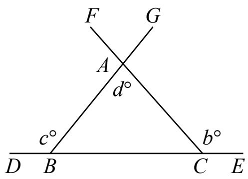
(a) $\left(\frac{4}{3}\right)\sqrt{3}$ (b) $4\sqrt{2}$
(c) $4\sqrt{3}$ (d) 4
(e) None of above

**37.** In the diagram below, *ABCD* is a rectangle. The area of isosceles right triangle *BCE* is 14, and $DE = 3EC$. What is the area of *ABCD*?




(a) 112 (b) 56
(c) 84 (d) $3\sqrt{28}$

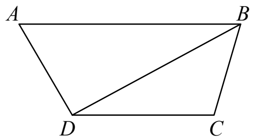
**38.** It is given that $d° = 70°$, $b° = 120°$. Then:




(a) $c° = 130°$
(b) $a° = 110°$
(c) Both (a) and (b) are correct
(d) Both (a) and (b) are wrong

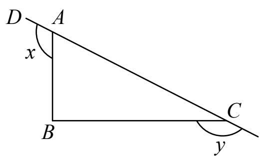
**39.** In the quadrilateral *ABCD*:

$AB + BC + CD + DA$ *is*



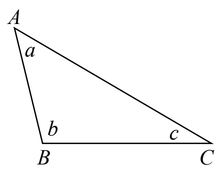

(a) Greater than 2*BD*
(b) Less than 2BD
(c) Equal to 2*BD*
(d) None of these

**40.** It is given that $AB \perp BC$. Which one of the following is true?




(a) $x + y = 180°$ (b) $x + y = 270°$
(c) $x + y = 300°$ (d) Cannot be said

**41.** ABC is a triangle. It is given that $a + c > 90°$, then $b$ is:




(a) Greater than 90° (b) Less than 90°
(d) Equal to 90° (d) Cannot be said

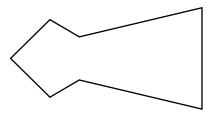
**42.** Which of the following are possible measure for the angles of a parallelogram?
(a) 90, 90, 90, 90
(b) 40, 70, 50, 150
(c) 50, 130, 50, 130

(1) (a) only (2) (b) only
(3) (c) only (4) (b) and (c) only

**43.** Find the distance of aperpendicular from the centre of a circle to the chord if the diameter of the circle is 30 cm and its chord is 24cm.
(a) 6 cm (b) 7 cm
(c) 9 cm (d) 10 cm

**44.** The medians *AD*, *BE* and *CF* of a triangle *ABC* intersect in G. Which of the following is true for any $\Delta ABC$?
(a) $GB + GC = 2GA$
(b) $GB + GC < GA$
(c) $GB + GC > GA$
(d) $GB + GC = GA$
(e) None of these

**45.** Find the sum of the degree measure of the internal angles in the polygon shown below.



(a) 600° (b) 720°
(c) 900° (d) 1080°
(e) 750°

**46.** A semi-circle is drawn with AB as its diameter. From C, a point on AB, a line perpendicular to AB is draw meeting the circumference of the semi-circle at D. Given that AC = 2 cm and CD = 6 cm the area of the semicircle (in $cm^2$) will be:

(a) $32\pi$ $cm^2$ (b) $50\pi$ $cm^2$
(c) $40.5\pi$ $cm^2$ (d) $81\pi$ $cm^2$
(e) undeterminable

**47.** An equilateral triangle BPC is drawn inside a square ABCD. What is the value of the angle APD in degrees:
(a) 75 (b) 90
(c) 12 (d) 135
(e) 150

**48.** The angles of a quadrilateral are in the ratio of 2:4:7:5. The smallest angle of the quadrilateral is equal to the smallest angle of a triangle. One of the angles of the triangle is twice the smallest angle of the triangle. What is the second largest angle of the triangle?

(a) 80° (b) 60°
(c) 120° (d) Cannot be determined

**[CBI (PO), 2010]**

**49.** Angle '*A*' of the quadrilateral *ABCD* is 26° less than angle *B*. Angle *B* is twice angle *C* and angle *C* is 10° more than the angle *D*. What would be the measure of angle '*A*'?

(a) 104° (b) 126°
(c) 56° (d) 106°

**[Corporation Bank PO, 2009]**

**50.** The ratio between the angles of a quadrilateral is 3:4:6:5. Two-thirds the largest angle of the quadrilateral is equal to the smaller angle of a parallelogram? What is the value of adjacent angle of the parallelogram?

(a) 120° (b) 110°
(c) 100° (d) 130°

**[OBC PO, 2010]**

**51.** The ratio between the adjacent angles of a parallelogram are 2:3. The smallest angle of a quadrilateral is equal to the half of the smallest angle of a parallelogram. The highest angle of a quadrilateral is 4 times greater than its smallest angle. What is the sum of the highest angle of a quadrilateral and the smallest angles of a parallelogram?

(a) 252° (b) 226°
(c) 144° (d) 180°

**[Union Bank of India PO, 2011]**

**52.** One of the angles of a triangle is two-thirds angle of sum of adjacent angles of parallelogram. Remaining angles of the triangle are in ratio 5:7 respectively. What is the value of second largest angle of the triangle?

(a) 25°
(b) 40°
(c) 35°
(d) Cannot be determined

**[Corporation Bank PO, 2011]**

**53.** Smallest angle of a triangle is equal to two-thirds the smallest angle of a quadrilateral. The ratio between the angles of the quadrilateral is 3:4:5:6. Largest angle of the triangle is twice its smallest angle. What is the sum of second largest angle of the triangle and largest angle of the quadrilateral?

(a) 160º (b) 180º
(c) 190º (d) 170º

**[Bank of Baroda PO Examination, 2011]**

**54.** The largest and the second largest angles of a triangle are in the ratio of 3:2, respectively. The smallest angle is 20% of the sum of the largest and the second largest angles. What is the sum of the smallest and the second largest angles?

(a) 80º (b) 60º
(c) 100º (d) 90º

**[Bank of Baroda PO, 2010]**

**55.** *a* and *b* are two sides adjacent to the right angle of a right-angle triangle and *p* is the perpendicular drawn to the hypotenuse from the opposite vertex. Then $p^2$ is equal to:

(a) $a^2+b^2$ (b) $\frac{1}{a^2}+\frac{1}{b^2}$
(c) $\frac{a^2b^2}{a^2+b^2}$ (d) $a^2-b^2$

**[SSC, 2014]**

**56.** Two chords of lengths *a* metres and *b* metres subtend angles 60°and 90° at the centre of the circle, respectively. Which of the following is true?

(a) $b=\sqrt{2}a$ (b) $a=\sqrt{2}b$
(c) $a = 2b$ (c) $b = 2a$

**[SSC, 2014]**

**57.** In a $\Delta ABC, \angle A+\frac{1}{2}\angle B+\angle C=140°$, then ∠B is:

(a) 50° (b) 80°
(c) 40° (d) 60°

**[SSC, 2014]**

**58.** The radius of a circle is 6 cm. The distance of a point lying outside the circle from the centre is 10 cm. The length of the tangent drawn from the outside point to the circle is:

(a) 5 cm (b) 6 cm
(c) 7 cm (d) 8 cm

**[SSC, 2014]**

**59.** If *ABCD* is a cyclic quadrilateral in which $\angle A=4x°,\ \angle B=7x°,\ \angle C=5y°,\ \angle D=y°$, then $x{:}y$ is:

(a) 3:4 (b) 4:3
(c) 5:4 (d) 4:5

**[SSC, 2014]**

**60.** *G* is the centroid of the equilateral Δ*ABC*. If *AB* = 10 cm, then length of *AG* is:

(a) $\frac{5\sqrt{3}}{3}$ cm (b) $\frac{10\sqrt{3}}{3}$ cm
(c) $5\sqrt{3}$ cm (d) $10\sqrt{3}$ cm

**[SSC, 2014]**

**61.** Two chords *AB* and *CD* of a circle with centre *O*, intersect each other at *P*. If $\angle AOD=100°$ and $\angle BOC=70°$, then the value of $\angle APC$ is

(a) 80° (b) 75°
(c) 85° (d) 95°

**[SSC, 2014]**

**62.** $ABCD$ is a cyclic quadrilateral and $AD$ is a diameter. If $\angle DAC = 55°$, then value of $\angle ABC$ is:
(a) 55° (b) 35°
(c) 145° (d) 125°
**[SSC, 2014]**

**63.** In $\Delta ABC$ a straight line parallel to $BC$ intersects $AB$ and $AC$ at $D$ and $E$, respectively. If $AB = 2AD$, then $DE:BC$ is:
(a) 2:3 (b) 2:1
(c) 1:2 (d) 1:3
**[SSC, 2014]**

**64.** $ABC$ is an isosceles triangle such that $AB = AC$ and $AD$ is the median to the base $BC$ with $\angle ABC = 35°$. Then $\angle BAD$ is:
(a) 35° (b) 55°
(c) 70° (d) 110°
**[SSC, 2014]**

**65.** A man goes 24 m due west and then 10 m due north. Now, the distance of him from the starting point is:
(a) 17 m (b) 26 m
(c) 28 m (d) 34 m
**[SSC, 2014]**

**66.** $\angle A$, $\angle B$, $\angle C$ are three angles of a triangle. If $\angle A - \angle B = 15°$, $\angle B - \angle C = 30°$, then $\angle A$, $\angle B$ and $\angle C$ are:
(a) 80°, 60°, 40° (b) 70°, 50°, 60°
(c) 80°, 65°, 35° (d) 80°, 55°, 45°
**[SSC, 2013]**

**67.** If $ABC$ is an equilateral triangle and $D$ is a point on $BC$ such that $AD \perp BC$, then:
(a) $AB:BD = 1:1$ (b) $AB:BD = 1:2$
(c) $AB:BD = 2:1$ (d) $AB:BD = 3:2$
**[SSC, 2013]**

**68.** $\Delta ABC$ is an isosceles triangle and $\overline{AB} = \overline{AC} = 2a$ units, $\overline{BC} = a$ units. Draw $\overline{AD} \perp \overline{BC}$ and find the length of $\overline{AD}$.
(a) $\sqrt{15}a$ units (b) $\sqrt{\frac{15}{2}}a$ units
(c) $\sqrt{17}a$ units (d) $\sqrt{\frac{17}{2}}a$ units
**[SSC, 2013]**

**69.** All sides of a quadrilateral $ABCD$ touch a circle. If $AB = 6$ cm, $BC = 7.5$ cm, $CD = 3$ cm, then $DA$ is:
(a) 3.5 cm (b) 4.5 cm
(c) 2.5 cm (d) 1.5 cm
**[SSC, 2013]**

**70.** In a right-angled triangle, the product of two sides is equal to half of the square of the third side, i.e., hypotenuse. One of the acute angles must be:
(a) 60° (b) 30°
(c) 45° (d) 15°
**[SSC, 2013]**

**71.** If two concentric circles are of radii 5 cm and 3 cm, then the length of the chord of the larger circle which touches the smaller circle is:
(a) 6 cm (b) 7 cm
(c) 10 cm (d) 8 cm
**[SSC, 2013]**

**72.** Inside a square $ABCD$, $\Delta BEC$ is an equilateral triangle. If $CE$ and $BD$ intersect at $O$, then $\angle BOC$ is equal to:
(a) 60° (b) 75°
(c) 90° (d) 120°
**[SSC, 2013]**

**73.** A point $D$ is taken from the side $BC$ of a right-angled triangle $ABC$, where $AB$ is hypotenuse. Then:
(a) $AB^2 + CD^2 = BC^2 + AD^2$
(b) $CD^2 + BD^2 = 2AD^2$
(c) $AB^2 + AC^2 = 2AD^2$
(d) $AB^2 = AD^2 + BD^2$
**[SSC, 2013]**

**74.** Let $C$ be a point on a straight line $AB$. Circles are drawn with diameters $AC$ and $AB$. Let $P$ be any point on the circumference of the circle with diameter $AB$. If $AP$ meets the other circle at $Q$, then:
(a) $QC \parallel PB$
(b) $QC$ is never parallel to $PB$
(c) $QC = \frac{1}{2}PB$
(d) $QC \parallel PB$ and $QC = \frac{1}{2}PB$
**[SSC, 2013]**

**75.** An isosceles triangle $ABC$ is right-angled at $B$. $D$ is a point inside the triangle $ABC$. $P$ and $Q$ are the feet of the perpendiculars drawn from $D$ on the sides $AB$ and $AC$, respectively of $\Delta ABC$. If $AP = a$ cm, $AQ = b$ cm and $\angle BAD = 15°$, then find sin 75°.
(a) $\frac{2b}{\sqrt{3}a}$ (b) $\frac{a}{2b}$
(c) $\frac{\sqrt{3}a}{2b}$ (d) $\frac{2a}{\sqrt{3}b}$
**[SSC, 2013]**

**76.** Each interior angle of a regular octagon in radians is:
(a) $\frac{\pi}{4}$ (b) $\frac{3\pi}{4}$
(c) $\frac{2\pi}{3}$ (d) $\frac{1}{3}\pi$
**[SSC, 2013]**

**77.** $D$ and $E$ are two points on the sides $AC$ and $BC$, respectively of $\Delta ABC$ such that $DE = 18$ cm, $CE = 5$ cm and $\angle DEC = 90°$. If tan $(\angle ABC) = 3.6$, then find $AC:CD$.

(a) $BC:2CE$ (b) $2CE:BC$
(c) $2CD:CE$ (d) $CE:2BC$

**[SSC, 2013]**

**78.** $D$ is a point on the side $BC$ of a triangle $ABC$ such that $AD \perp BC$. $E$ is a point on $AD$ for which $AE:ED = 5:1$. If $\angle BAD = 30°$ and tan $(\angle ACB) = 6$ tan $(\angle DBE)$, then find $\angle ACB$.

(a) 30° (b) 45°
(c) 60° (d) 15°

**[SSC, 2013]**

**79.** If the internal bisectors of $\angle ABC$ and $\angle ACB$ of $\Delta ABC$ meet at $O$ and also $\angle BAC = 80°$, then $\angle BOC$ is equal to:

(a) 50° (b) 160°
(c) 40° (d) 130°

**[SSC Assistant Grade III, 2013]**

**80.** $O$ is the incenter of $\Delta ABC$. If $\angle BOC = 116°$, then $\angle BAC$ is:

(a) 42° (b) 62°
(c) 58° (d) 52°

**[SSC Assistant Grade III, 2013]**

**81.** Inside a triangle $ABC$, a straight line parallel to $BC$ intersects $AB$ and $AC$ at the points $P$ and $Q$, respectively. If $AB = 3PB$, then $PQ:BC$ is:

(a) 1:3 (b) 3:4
(c) 1:2 (d) 2:3

**[SSC Assistant Grade III, 2013]**

**82.** O is the circumcentre of $\Delta ABC$. If $\angle BAC = 85°$, $\angle BCA = 75°$, then $\angle OAC$ is equal to:

(a) 70° (b) 60°
(c) 80° (d) 100°

**[SSC Assistant Grade III, 2012]**

**83.** The distance between the centres of the two circles with radii 4 cm and 9 cm is 13 cm. The length of the direct common tangent (between two points of contact) is:

(a) 13 cm (b) $\sqrt{153}$ cm
(c) 12 cm (d) 18 cm

**[SSC Assistant Grade III, 2012]**

**84.** The external bisector of $\angle ABC$ of $\Delta ABC$ intersects the straight line through A and parallel to $BC$ at the point D. If $\angle ABC = 50°$, then measure of $\angle ADB$ is:

(a) 65° (b) 55°
(c) 40° (d) 20°

**[SSC Assistant Grade III, 2012]**

**85.** $AB$ is a diameter of a circle with centre at O. $DC$ is a chord of it such that $DC \parallel AB$. If $\angle BAC = 20°$, then $\angle ADC$ is equal to:

(a) 120° (b) 110°
(c) 115° (d) 100°

**[SSC Assistant Grade III, 2012]**

**86.** The tangents drawn at $P$ and $Q$ on the circumference of a circle intersect at A. If $\angle PAQ = 68°$, then the measure of the $\angle APQ$ is:

(a) 56° (b) 68°
(c) 28° (d) 34°

**[SSC Assistant Grade III, 2012]**

**87.** If the incentre of an equilateral triangle lies inside the triangle and its radius is 3 cm, then the side of the equilateral triangle is:

(a) $9\sqrt{3}$ cm (b) $6\sqrt{3}$ cm
(c) $3\sqrt{3}$ cm (d) 6 cm

**[SSC, 2012]**

**88.** Suppose $\Delta ABC$ be a right-angled triangle where $\angle A = 90°$ and $AD \perp BC$. If Area $(\Delta ABC) = 40$ cm$^2$, Area $(\Delta ACD) = 10$ cm$^2$ and $AC = 9$ cm, then the length of $BC$ is:

(a) 12 cm (b) 18 cm
(c) 4 cm (d) 6 cm

**[SSC, 2012]**

**89.** Two circles touch each other externally at $P$. $AB$ is a direct common tangent to the two circles, $A$ and $B$ are points of contact and $\angle PAB = 35°$. Then $\angle ABP$ is:

(a) 35° (b) 55°
(c) 65° (d) 75°

**[SSC, 2012]**

**90.** The length of the common chord of two intersecting circles is 24 cm. If the diameters of the circles are 30 cm and 26 cm, then the distance between the centres in cm is:

(a) 13 (b) 14
(c) 15 (d) 16

**[SSC, 2012]**

**91.** In $\Delta ABC$, $D$ and $E$ are points on $AB$ and $AC$ respectively such the $DE \parallel BC$ and $DE$ divides the $\Delta ABC$ into two parts of equal areas. Then ratio $AD:BD$ is:

(a) 1:1 (b) $1:\sqrt{2}-1$
(c) $1:\sqrt{2}$ (d) $1:\sqrt{2}+1$

**[SSC, 2012]**

**92.** $X$ and $Y$ are centres of circles of radii 9 cm and 2 cm respectively, $XY = 17$ cm. $Z$ is the centre of a circle of radius $r$ cm which touches the above circles externally. Given that $\angle XZY = 90°$, the value of $r$ is:

(a) 13 cm (b) 6 cm
(c) 9 cm (d) 8 cm

**[SSC, 2012]**

**93.** *I* is the incentre of a triangle *ABC*. If $\angle ABC = 65°$ and $\angle ACB = 55°$, then the value of $\angle BIC$ is:
(a) 130° (b) 120°
(c) 140° (d) 110°

**[SSC, 2012]**

**94.** If the radii of two circles be 6 cm and 3 cm and the length of the transverse common tangent be 8 cm, then the distance between the two centres is:
(a) $\sqrt{145}$ cm (b) $\sqrt{140}$ cm
(c) $\sqrt{150}$ cm (d) $\sqrt{135}$ cm

**[SSC, 2012]**

**95.** The ratio between the numbers of sides of two regular polygons is 1:2 and the ratio between their interior angles is 2:3. The number of sides of these polygons is respectively:
(a) 6 (b) 8
(c) 4 (d) 5

**[SSC, 2012]**

**96.** The angles of a triangle are in Arithmetic Progression. The ratio of the least angle in degrees to the number of radians in the greatest angle is $60:\pi$ .The angles in degrees are:
(a) 30°, 60°, 90° (b) 35°, 55°, 90°
(c) 40°, 50°, 90° (d) 40°, 55°, 85°

**[SSC, 2012]**

**97.** *A*, *B*, *C* are three points on a circle. The tangent at *A* meets *BC* produced at *T*, $\angle BTA = 40°$, $\angle CAT = 44°$. The angle subtended by *BC* at the centre of the circle is:
(a) 84° (b) 92°
(c) 96° (d) 104°

**[SSC, 2011]**

**98.** If the length of a chord of a circle at a distance of 12 cm from the centre is 10 cm, then the diameter of the circle is:
(a) 13 cm (b) 15 cm
(c) 26 cm (d) 30 cm

**[SSC, 2011]**

**99.** In $\Delta ABC$, *P* and *Q* are the middle points of the sides *AB* and *AC* respectively. *R* is a point on the segment *PQ* such that $PR:RQ = 1:2$. If $PR = 2$ cm, then $BC =$
(a) 4 cm (b) 2 cm
(c) 12 cm (d) 6 cm

**[SSC, 2011]**

**100.** If O is the circumcentre of $\Delta ABC$ and $\angle OBC = 35°$, then the $\angle BAC$ is equal to:
(a) 55° (b) 110°
(c) 70° (d) 35°

**[SSC, 2011]**

**101.** If I is the incentre of ΔABC and ∠BIC = 135°, then ΔABC is:
(a) acute angled (b) equilateral
(c) right angled (d) obtuse angled

**[SSC, 2011]**

**102.** What is the length of the radius of the circum-circle of the equilateral triangle, the length of whose side is $6\sqrt{3}$ cm?
(a) $6\sqrt{3}$ cm (b) 6 cm
(c) 5.4 cm (d) $3\sqrt{6}$ cm

**[SSC, 2010]**

**103.** The ratio of the adjacent angles of a parallelogram is 7:8. Also, the ratio of the angles of quadrilateral is 5:6:7:12. What is the sum of the smaller angle of the parallelogram and the second largest angle of the quadrilateral?
(a) 168° (b) 228°
(c) 156° (d) 224°
(e) None of these

**[IOB PO, 2011]**

**104.** One of the angles of a triangle is two-thirds of the sum of the adjacent angles of parallelogram. Remaining angles of the triangle are in the ratio 5:7. What is the value of the second largest angle of the triangle?
(a) 25° (b) 40°
(c) 35° (d) Cannot be determined
(e) None of these

**[Corporation Bank PO, 2011]**

**105.** Angle '*A*' of a quadrilateral *ABCD* is 26° less than angle *B*. Angle *B* is twice angle *C* and angle *C* is 10° more than angle *D*. What would be the measure of angle *A*?
(a) 104° (b) 126°
(c) 56° (d) 132°
(e) 106°

**[Corporation Bank PO, 2009]**

**106.** A number when subtracted by $\frac{1}{7}$ of itself gives the same value as the sum of all the angles of a triangle. What is the number?
(a) 224 (b) 210
(c) 140 (d) 350
(e) 187

**[Corporation Bank PO, 2009]**

## ANSWER KEYS

### Exercise–I

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (b) | **3.** (a) | **4.** (d) | **5.** (a) | **6.** (d) | **7.** (a) | **8.** (b) | **9.** (a) | **10.** (c) | **11.** (b) | **12.** (d) |
| **13.** (c) | **14.** (b) | **15.** (b) | **16.** (d) | **17.** (a) | **18.** (c) | **19.** (a) | **20.** (a) | **21.** (b) | **22.** (c) | **23.** (c) | **24.** (a) |
| **25.** (a) | **26.** (d) | **27.** (b) | **28.** (c) | **29.** (a) | **30.** (c) | **31.** (a) | **32.** (b) | **33.** (c) | **34.** (a) | **35.** (d) | **36.** (b) |
| **37.** (d) | **38.** (b) | **39.** (c) | **40.** (d) | **41.** (a) | **42.** (d) | **43.** (b) | **44.** (b) | **45.** (b) | **46.** (c) | **47.** (b) | **48.** (c) |
| **49.** (b) | **50.** (a) | **51.** (d) | **52.** (c) | **53.** (a) | **54.** (c) | **55.** (d) | **56.** (d) | **57.** (a) | **58.** (d) | **59.** (a) | **60.** (c) |
| **61.** (c) | **62.** (d) | **63.** (a) | **64.** (c) | **65.** (a) | **66.** (a) | **67.** (a) | **68.** (c) | **69.** (b) | **70.** (c) | **71.** (d) | **72.** (d) |
| **73.** (a) | **74.** (b) | **75.** (c) | **76.** (b) | **77.** (a) | **78.** (d) | **79.** (c) | **80.** (c) | **81.** (a) | **82.** (d) | **83.** (c) | **84.** (c) |
| **85.** (b) | **86.** (d) | **87.** (a) | **88.** (c) | **89.** (c) | **90.** (c) | **91.** (a) | **92.** (b) | **93.** (d) | **94.** (a) | **95.** (d) | **96.** (c) |
| **97.** (b) | **98.** (d) | **99.** (a) | **100.** (c) | **101.** (a) | **102.** (d) | **103.** (b) | **104.** (c) | | | | |

### Exercise–I

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (c) | **2.** (c) | **3.** (d) | **4.** (c) | **5.** (a) | **6.** (b) | **7.** (a) | **8.** (a) | **9.** (a) | **10.** (b) | **11.** (a) | **12.** (b) |
| **13.** (d) | **14.** (c) | **15.** (c) | **16.** (d) | **17.** (d) | **18.** (d) | **19.** (b) | **20.** (b) | **21.** (d) | **22.** (d) | **23.** (d) | **24.** (b) |
| **25.** (d) | **26.** (b) | **27.** (b) | **28.** (c) | **29.** (a) | **30.** (a) | **31.** (d) | **32.** (d) | **33.** (b) | **34.** (c) | **35.** (d) | **36.** (c) |
| **37.** (a) | **38.** (c) | **39.** (a) | **40.** (b) | **41.** (b) | **42.** (c) | **43.** (c) | **44.** (c) | **45.** (c) | **46.** (b) | **47.** **(e)** | **48.** (b) |
| **49.** (d) | **50.** (c) | **51.** (d) | **52.** (c) | **53.** (b) | **54.** (d) | **55.** (c) | **56.** (a) | **57.** (b) | **58.** (d) | **59.** (b) | **60.** (b) |
| **61.** (d) | **62.** (c) | **63.** (c) | **64.** (b) | **65.** (b) | **66.** (c) | **67.** (c) | **68.** (b) | **69.** (d) | **70.** (c) | **71.** (d) | **72.** (b) |
| **73.** (a) | **74.** (d) | **75.** (c) | **76.** (b) | **77.** (c) | **78.** (c) | **79.** (d) | **80.** (d) | **81.** (d) | **82.** (a) | **83.** (c) | **84.** (a) |
| **85.** (b) | **86.** (a) | **87.** (b) | **88.** (b) | **89.** (b) | **90.** (b) | **91.** (b) | **92.** (b) | **93.** (b) | **94.** (a) | **95.** (c) | **96.** (a) |
| **97.** (d) | **98.** (c) | **99.** (c) | **100.** (a) | **101.** (c) | **102.** (b) | **103.** (a) | **104.** (c) | **105.** **(e)** | **106.** (b) | | |

## EXPLANATORY ANSWERS

### Exercise-I

**1. (c)** Let the measured of the required angle be $x$ degree. Then, its supplement = $180 - x$

Now, angle $= \frac{1}{3}$ (its supplement)

$x = \frac{1}{3}(180 - x)$

$3x + x = 180° \Rightarrow x = 45°$.

**2. (b)** complement of 30°20′ = 90° – (30°20′) = 90° – (30° + 20′)

= (89° – 30°) + (1° – 20′)

= 59° + 60′ – 20′ [∵ 1° = 60°′]

= 59° + 40′ = 59°40′.

**3. (a)** Since OP bisects $\angle BOC$,

$\therefore \quad \angle BOC = 2\angle POC$

Again, $OQ$ bisects $\angle AOC$, ∴,

$\angle AOC = 2\angle QOC$

Since ray $OC$ stands on line $AB$, ∴,

$\angle AOC + \angle BOC = 180° \quad \Rightarrow \quad 2\angle QOC + 2\angle POC = 180°$

$\Rightarrow \quad 2\angle QOC + \angle POC = 180°$

$\Rightarrow \quad \angle QOC + \angle POC = 90°$

$\Rightarrow \quad \angle POQ = 90°$.

The above sum can also be restated as follows; The angle between the bisectors of a linear pair of angles is a right angle.

**4. (d)** Through $O$, draw a line $l$ parallel to both $AB$ and $CD$. Then

$\angle 1 = 45°$ (alt. ∠S)

and $\angle 2 = 30°$ (alt. ∠S)

$\therefore \quad \angle BOC = \angle 1 + \angle 2 = 45° + 30° = 75°$

So, $X = 360° - \angle BOC = 360° - 75° = 285°$

Hence $X = 285°$.

**5.** **(a)** AB || CD and $t$ transversal intersects them at $E$ and F

$\angle BEF + \angle EFD = 180°$ (co-interior angles)

$\Rightarrow \ \frac{1}{2}\angle BEF + \frac{1}{2}\angle EFD = 180°$

$\Rightarrow \ \angle BEF + \Delta EFD = 90°$

In $\angle EFG$

$\angle EFG + \angle FEG + \angle EGF = 180°$

$\therefore \ \angle EGF + 90° = 180°$

$\therefore \ \angle EGF = 90°$.

The above result can be restated as:

If two parallel lines are cut by a transversal, then the bisectors of the interior angles on the same side of the transversal intersect each other at right angles.

**6.** **(d)**

$\angle DCK = \angle FDG = 55°$ (corr. $\angle s$)

$\therefore \ \angle ACE = \angle DCK = 55°$ (vert. opp. $\angle s$)

So, $\angle AEC = 180° - (40° + 55°) = 85°$

$\therefore \ \angle HAB = \angle AEC = 85°$ (corr. $\angle s$)

Hence, $x = 85°$.

**7.** **(a)** Let, the measure of the required angled be $x°$.

Then, measure of its complement = $(90 - x)°$ measure of its supplement = $(180 - x)°$

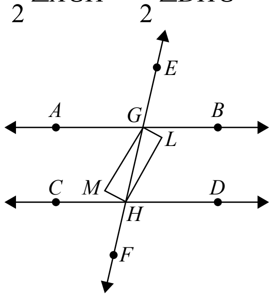
$6(90° - x) = 2(180° - x) - 12°$

$\Rightarrow \ 540° - 6x = 360° - 2x - 12°$

$\Rightarrow \ 4x = 192° \ \Rightarrow \ x = 48°$.

**8.** **(b)** $\angle AGH = \angle DHG$ (alt. int. angles)

$\frac{1}{2}\angle AGH = \frac{1}{2}\angle DHG \ \Rightarrow \ \angle HGM = \angle GHL$




Thus, lines $GM$ and $HL$ are intersected by a transversal $GH$ at $G$ and $H$ respectively such that pair of alternate angles are equal, i.e., $\therefore \ \angle HGM = \angle GHL$

$\therefore \ GM \parallel HL$

Similarly, $GL \parallel HM$

So, $GMHL$ is a $\parallel_{gm}$.

Since $AB \parallel CD$ and $EF$ is a transversal

$\therefore \ \angle BGH + \angle DHG = 180°$ [co-interior angles]

$\therefore \ \frac{1}{2}\angle BGH + \frac{1}{2}\angle DHG = 90°$

$\Rightarrow \ \angle LGH + \angle LHG = 90°$

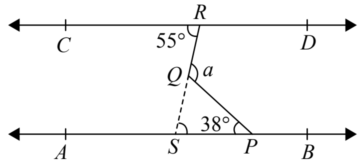
But $\angle LGH + \angle LHG + \angle GLH = 180°$

$\therefore \ 90° + \angle GLH = 180° \ \Rightarrow \ \angle GLH = 90°$

Thus, in $\parallel_{gm}$ $GMHL$, we have $\angle GLH = 90°$

Hence, $GMHL$ is a rectangle.

**9.** **(a)** CD || AB (Given)




Produce $RQ$ to meet $AB$ in $S$

$\angle CRS = \angle PSR$ (at. int. $\angle s$)

But $\angle CRS = 55°$

$\therefore \ \angle PSR = 55°$

Now in $QSP$

$\angle QSP + \angle QPS + \angle PQS = 180°$

$55° + 38° + \angle SQP = 180°$

$\therefore \ \angle SQP = 180° - 93° = 87°$

But angle a and $\angle PQS$ are linear

$\angle a = 180° - 87°$

$\angle a = 93°$

**10.** **(c)** Let, the angle be $x \ \Rightarrow$ Its complement = $90° - x$

According to the question

$(90 - x) = x + 60° \ \Rightarrow \ x = 15°$

**11.** **(b)** $\angle DAC = \angle B + \angle C$

(Exterior angle prop. of a $\Delta$)

$130° = 2x + 3x$

$5x = 130°$

$x = 26°$

$\therefore \ \angle B = 52°; \angle C = 78°$.

**12.** **(d)** $\angle B = \angle C \ \Rightarrow \ AB = BC$

$\angle CAD = 30°$

$\therefore \ \angle CAD > \angle CDA \ \Rightarrow \ CD > AC$

(In a $\Delta$, greater angle has longer side opposite to it)

$\angle BAC = 180° - 110° = 70° > \angle ABC$

$\Rightarrow \ BC > AB$ and $BC > AC$

$\therefore \ BC > CA$ and $CA < CD$

**13.** **(c)** Let, $2\angle A + 3\angle B = 6\angle C = K$

$\therefore \ \angle A = \frac{K}{2}, \angle B = \frac{K}{3}, \angle C = \frac{K}{6}$

But $\angle A + \angle B + \angle C = 180°$

$\therefore \frac{k}{2} + \frac{k}{3} + \frac{k}{6} = 180°$

$K = 180°$

Hence, $\angle A = \frac{180°}{2} = 90°$.

**14.** **(b)** Since $A$, $B$ and $C$ are the angles of a $\Delta$,

$\therefore \ A + B + C = 180°$

Now $A - B = 15°$; $B - C = 30°$; $\therefore \ B = C + 30°$

$\therefore \ \angle A = B + 15° = C + 30° + 15° = C + 45°$

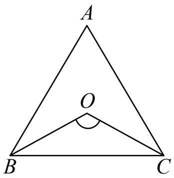
$\therefore \ A + B + C = (C + 45°) + (C + 30°) + C$

$3C = 180° - 75° = 105°$

$C = 35°$

$\therefore \quad \angle A = 35° + 45° = 80°.$

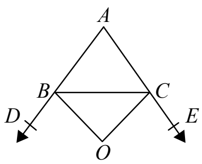
**15.** **(b)** $\angle BOC = 90° + \frac{1}{2}\angle A$




$\therefore \quad \angle BOC = 90° + \frac{1}{2}(70°) = 90° + 35°$

$\angle BOC = 125°.$

**16.** **(d)** $\angle BOC = 90° - \frac{1}{2}\angle A$




$\therefore \quad \angle BOC = 90° - \frac{1}{2}(40°)$

$= 90° - 20°$

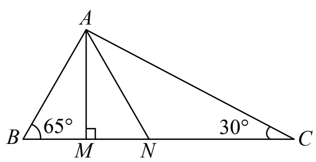
$\angle BOC = 70°.$

**17.** **(a)** $\angle MAN = \frac{1}{2}(\angle B - \angle C)$

$\angle MAN = \frac{1}{2}(65° - 30°)$

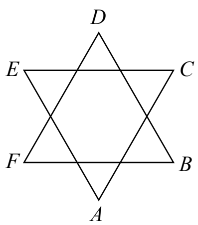
$= \frac{1}{2} \times 35°$

$\angle MAN = 17.5°.$




**18.** **(c)** In $\Delta ACE$

$\angle A + \angle C + \angle E = 180°$




Similarly in $\Delta DFB$

$\angle D + \angle F + \angle B = 180°$

$\therefore \quad (\angle A + \angle C + \angle E) + (\angle A + \angle C + \angle E) = 360°.$

**19.** **(a)** Since $DE \parallel BC$, $\therefore \quad \frac{AB}{AD} = \frac{AC}{AE}$

$\therefore \quad \frac{68}{17} = \frac{9}{AE}$

or, $AE = \frac{9}{4} = 2.25$ cm.

**20.** **(a)** Since, the diagonals of a trapezium divide each other proportionally

$\therefore \quad \frac{AO}{OC} = \frac{BO}{OD}$

$$\frac{3x-19}{x-5} = \frac{x-3}{3}$$

$\Rightarrow \quad 3(3x-19) = (x-3)(x-5)$

$\Rightarrow \quad 9x - 57 = x^2 - 8x + 15$

$\Rightarrow \quad x^2 - 17x + 72 = 0$

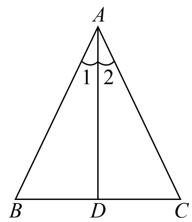
$\Rightarrow \quad x = 8$ or $x = 9$.

**21.** **(b)** Since $\angle 1 = \angle 2$

$\therefore \quad \frac{AB}{AC} = \frac{BD}{CD}$

But $BD = CD$ (given)

$\therefore \quad \frac{AB}{AC} = 1$




$AB = AC$ $\therefore$ the given $\Delta$ is isosceles

**22.** **(c)** $PR = \sqrt{PM^2 + MR^2} = \sqrt{36 + 64} = 10$ cm

$PQ = \sqrt{QR^2 - PR^2} = \sqrt{26^2 - 10^2} = 24$ cm

$\therefore \quad$ ar($\Delta PQR$) = $1 \times 10 \times 12 = 120$ cm$^2$.

**23.** **(c)** **Solution** Let $ABC$ and $DEF$ be the two similar $\Delta$s having area 81 cm$^2$ and 144 cm$^2$ respectively: Let $BC$ = 27 cm

Then since $\Delta ABC \sim \Delta DEF$

$\therefore \quad \frac{ar(\Delta ABC)}{ar(\Delta DEF)} = \frac{BC^2}{EF^2}$ (area Theorem)

$\frac{81}{144} = \frac{(27)^2}{x^2} \quad \Rightarrow \quad \frac{9}{12} = \frac{27}{x}$

$\therefore \quad x = 36$ cm.

**24.** **(a)** In $\Delta$s$ADE$ and $\Delta ABC$

$\angle A = \angle A$ [common]

$\angle ADE = \angle ACB = x°$(Given)

$\therefore \quad \Delta ADE \sim \Delta ACB$ (AA Similarly)

$$\frac{AD}{AC} = \frac{AE}{AB}$$

(corresponding sides of ~ Δs are proportional)

$$\frac{6}{13} = \frac{9}{AB}$$

$$AB = \frac{39}{2} = 19.5 \text{ cm}$$

Hence $BD = AB - AD = 19.5 - 6 = 13.5$ cm.

**25.** **(a)** In $\Delta ABC$, $AD$ is the bisector of $\angle A$

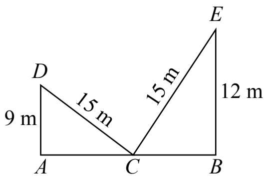
$$\frac{AB}{AC} = \frac{BD}{CD} \text{ (Internal bisector prop.)}$$

$$\frac{4}{5.2} = \frac{3}{DC} \Rightarrow DC = 3.9 \text{ cm}$$

But $BC = BD + CD = 3$ cm $+ 3.9$ cm $= 6.9$ cm.

**26.** **(d)** $AC = \sqrt{DC^2 - AD^2} = \sqrt{15^2 - 9^2}$

$= \sqrt{144} = 12$ cm




$$CB = \sqrt{CE^2 - BE^2} = \sqrt{15^2 - 12^2}$$

$$= \sqrt{81} = 9 \text{ m}$$

∴ Width of the street $(AC + BC) = AB = 12 + 9 = 21$ m.

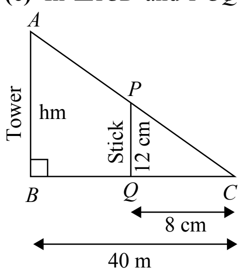
**27.** **(b)** Clearly $DE \parallel BC$ (by converse of $BPT$)

∴ $\Delta ADE \sim ABC$ ($\angle A = \angle A$ and $\angle ADE = \angle B$)

$$\therefore \frac{ar(\Delta ADE)}{ar(\Delta ABC)} = \frac{AD^2}{AB^2} \text{ (Area Theorem)}$$

$$= \frac{AD^2}{(2AD)^2} = \frac{1}{4} \quad (\because \ AB = 2AD)$$

**28.** **(c)** In $\Delta ACB$ and $PCQ$




$\angle C = \angle C$ (common)

$\angle ABC = \angle PQC$ (each 90°)

∴ $\Delta ACB \sim \Delta PC$ (AA Similarity)

$$\therefore \frac{AB}{PQ} = \frac{BC}{QC}$$

$$\frac{h}{12} = \frac{4000}{8}$$

$$h = 60 \text{ m.}$$

**29.** **(a)** Since $\frac{AD}{DB} = \frac{AE}{EC} = \frac{2}{3}$

∴ $DE \parallel BC$ (by converse of $BPT$)

∴ $\Delta ADE \sim \Delta ABC$ (AA similarity)

$$\frac{AD}{AB} = \frac{DE}{BC}$$

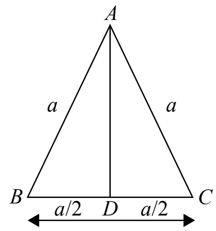
$$\frac{8}{20} = \frac{DE}{BC}$$

$$\frac{2}{5} = \frac{DE}{BC} \Rightarrow \frac{BC}{DE} = \frac{5}{2}.$$

**30.** **(c)** Lat $AB = BC = AC = a$

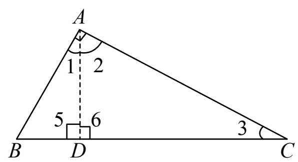
$AB^2 = AD^2 + BD^2$ (Pythagoras Theorem)

$$a^2 = AD^2 + \frac{a^2}{4}$$




$$\frac{3a^2}{4} = AD^2.$$

**31.** **(a)** Since $\angle 1 + \angle 2 = \angle 2 + 3$ (Each 90°)




∴ $\angle 1 = \angle 3$ [Each 90°]

Also $\angle 5 = \angle 6$

∴ $\Delta ADB \sim \Delta CDA$ [AA Similarity]

$$\frac{AD}{CD} = \frac{DB}{AD} \Rightarrow AD^2 = BD \times CD.$$

**32.** **(b)** Since diagonals of ||gm bisect each other, ∴ $M$ will be the mid-point of each of the diagonal $AC$ and $BD$

∴ In $\Delta ABC$ $AB^2 + BC^2 = 2(AM^2 + MB^2)$ [Appolonius Theorem]

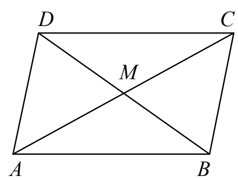
In $\Delta ADC$ $AD^2 + CD^2 = 2(AM^2 + DM^2)$

$= 2(AM^2 + MB^2)$ [∵ $DM = BM$]

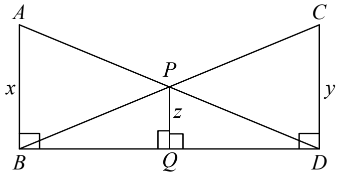
Adding $AB^2 + BC^2 + CD^2 + DA^2$

$= 4AM^2 + 4MB^2$

$= (2AM)^2 + (2MB)^2 = AC^2 + BD^2$.



**33.** **(c)** Since $\angle ABD = \angle CDB = \angle PQB = 90°$




$\therefore\ AB \parallel PQ \parallel CD \Rightarrow \Delta BQP \sim \Delta BDC$ (AA simlarity)

$$\frac{BQ}{BD} = \frac{QP}{DC} \qquad \cdots(1)$$

Also $\Delta DQP \sim \Delta DBA$ (AA similarity)

$$\frac{DQ}{BD} = \frac{QP}{BA} \qquad \cdots(2)$$

Adding (1) and (2), $\dfrac{BD}{BD} = QP\left(\dfrac{1}{DC} + \dfrac{1}{BA}\right)$

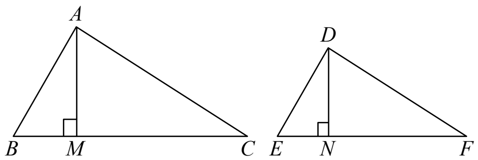
$$= \frac{1}{PQ} = \frac{1}{BA} + \frac{1}{CD} \quad \Rightarrow \quad \frac{1}{z} = \frac{1}{x} + \frac{1}{y}.$$

**34.** **(a)**

$$\frac{ar(\Delta ABC)}{ar(\Delta DEF)} = \frac{AM^2}{DN^2}$$

$$\frac{121}{81} = \frac{AM^2}{DN^2}$$

$$\therefore \frac{AM}{DN} = \frac{11}{9}$$




**35.** **(d)** $\Delta ADE \sim \Delta ABC$ (AA Similarity)

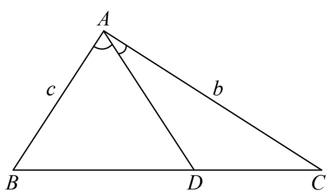
$$\therefore \quad \frac{ar(\Delta ADE)}{ar(\Delta ABC)} = \frac{DE^2}{BC} = \frac{9}{25} \quad \text{(area Them.)}$$

Let $ar(\Delta ADE) = 9x$ sq units. Then, $ar(\Delta ABC) = 25x$ sq. units

Now $ar(\text{trap. } BCED) = ar(\Delta ABC) - ar(\Delta ADE) = 16x$ sq. units

Hence $\dfrac{ar(\Delta ADE)}{ar(\text{trap } BCED)} = \dfrac{9x}{16x} = \dfrac{9}{16}.$

**36.** **(b)** Since $AD$ bisects $\angle BAC$




$$\frac{c}{b} = \frac{BD}{CD} \quad \text{(Internal bisector prop.)}$$

Adding 1 to both the sides

$$\frac{c+b}{b} = \frac{BD+CD}{CD}$$

$$\frac{c+b}{b} = \frac{a}{CD} \quad \Rightarrow \quad CD = \frac{ab}{b+c}.$$

Similarly it can be proved that $BD = \dfrac{ac}{b+c}$

Also $BD + CD = BC$

$$\therefore \quad BD + \frac{ab}{b+c} = a$$

$$BD = a - \frac{ab}{b+c} \quad \Rightarrow \quad \frac{ab+ac-ab}{b+c} = \frac{ac}{b+c}.$$

**37.** **(d)** $ar(\Delta ABC) = \dfrac{1}{2}bc$

Also $ar(\Delta ABC) = \dfrac{1}{2}BC \times AD = \dfrac{1}{2}\sqrt{b^2+c^2} \times AD$

$[\because\ BC^2 = b^2 + c^2]$

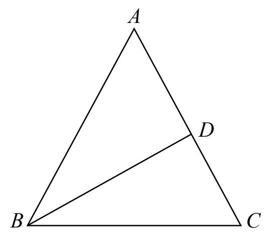
$$\therefore \quad \frac{1}{2}\sqrt{b^2+c^2} \times AD = \frac{1}{2}bc \quad \Rightarrow \quad AD = \frac{bc}{\sqrt{b^2+c^2}}.$$

**38.** **(b)** Since $BC^2 = AC \times CD$

$$\therefore \quad \frac{BC}{CD} = \frac{AC}{BC} \text{ and } \angle C = \angle C$$

$\therefore\ \Delta ABC \sim \Delta BDC$ (SAS Similarity)

$$\frac{AB}{BD} = \frac{BC}{DC} = \frac{AC}{BC}$$



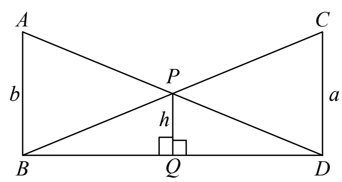

But $AB = AC$

$$\therefore \quad \frac{1}{BD} = \frac{1}{BC} \quad \Rightarrow \quad BD = BC.$$

**39.** **(c)** $\dfrac{1}{h} = \dfrac{1}{a} + \dfrac{1}{b}$

$$\frac{1}{h} = \frac{a+b}{ab}$$

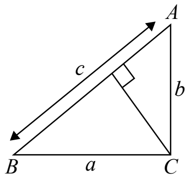
$$\therefore \quad h = \frac{ab}{a+b}.$$




**40.** **(d)** $p = \dfrac{ba}{\sqrt{b^2+a^2}}$

$$\frac{1}{p^2} = \frac{b^2 + a^2}{b^2 a^2}$$

$$\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2}.$$




**41.** **(a)** $\Delta ADE \sim \Delta AB\ C$($\because$ $DE \parallel BC$ $\therefore$ $AA$ Similrity)

$$\frac{AD}{AB} = \frac{DE}{BC}$$

$$\therefore \quad \frac{5x}{5x + 4x} = \frac{DE}{BC}$$

$$\frac{5}{9} = \frac{DE}{BC}$$

Now, $\dfrac{ar(\Delta DFE)}{ar(\Delta CFB)} = \dfrac{5^2}{9^2} = \dfrac{25}{81}.$

**42.** **(d)** $ar(\Delta ABC) = 2\ ar(\Delta XBY)$

$$\frac{ar(\Delta XBY)}{ar(\Delta ABC)} = \frac{1}{2} \qquad \cdots(1)$$

But $\Delta XBY \sim \Delta ABC$ ($\because$ $XY \parallel AC$)

$$\therefore \quad \frac{ar(\Delta XBY)}{ar(\Delta ABC)} = \frac{XB^2}{AB^2} \text{ (Area Thm.)} \qquad \cdots(2)$$

$$\therefore \quad \frac{XB}{AB} = \frac{1}{\sqrt{2}}$$

$$\frac{AB - AX}{AB} = \frac{1}{\sqrt{2}}$$

$$\therefore \quad \frac{AX}{AB} = \frac{\sqrt{2} - 1}{\sqrt{2}}.$$

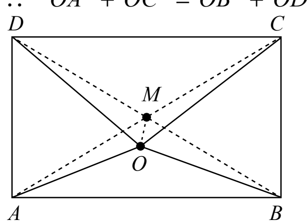
**43.** **(b)** Since the diagonals of a rectangle are equal and bisect each other. Let $AC$ and $BD$ intersect at $M$. Therefore $M$ is the mid-point of $AC$ and $BD$ and $AM = DM$

From $\Delta AOC$, $OA^2 + OC^2 = 2(AM^2 + MO^2)$

[Apploinus Thm.]

also in $\Delta ODB$, $OB^2 + OB^2 = 2(MO^2 + DM^2) = 2(MO^2 + AM^2)$

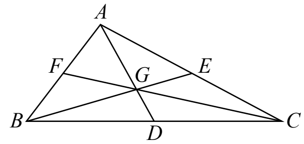
$\therefore \quad OA^2 + OC^2 = OB^2 + OD^2$.




**44.** **(b)** We know that the centroid of a $\Delta$ divides each median in the ratio of 2 : 1

$$\therefore \quad BG : BE = 2 : 3 \quad \Rightarrow \quad BE = \frac{3}{2} BG$$

$$\Rightarrow \quad BE = \frac{3}{2} \times 6 = 9 \text{ cm}.$$




**45.** **(b)** Let the altitudes $AL$, $BM$ and $CN$ of $\Delta ABC$ intersect at $H$. Then $H$ is the orthocentre of $\Delta ABC$.

In $\Delta ABC$, $HL \perp BC$ and $BN \perp CH$.

Thus, the two altitudes $HL$ and $BN$ of $\Delta HBC$, intersects at $A$.

**46.** **(c)** Since every exterior angle is equal to sum of interior opposite angles,

So, $\angle a = A + B$, $\angle b = B + C$ and $\angle c = A + C$

$\therefore \quad \angle a + \angle b + \angle c = 2(A + B + C) = 2 \times 180° = 360°$.

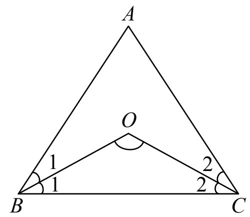
**47.** **(b)** Incentre of every triangle lies in its interior.

**48.** **(c)** In $\Delta ABC$, $\angle A + \angle B + \angle C = 180°$

$$\frac{1}{2}\angle A + \frac{1}{2}\angle B + \frac{1}{2}\angle C = 90°$$

$$\frac{1}{2}\angle A + \angle 1 + \angle 2 = 90°$$

$$\angle 1 + \angle 2 = 90° - \frac{1}{2}\angle A \qquad \cdots(1)$$




Now in $\Delta BOC$,

$\angle 1 + \angle 2 + \angle BOC = 180°$

$$\left(90° - \frac{1}{2}\angle A\right) + \angle BOC = 180° \text{ (using(i))}$$

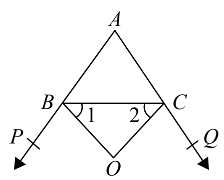
$$\Rightarrow \quad \angle BOC = 90° + \frac{1}{2}\angle A.$$

**49.** **(b)** We have $\angle B + \angle CBP = 180°$ (Linear pair)

$$\Rightarrow \quad \frac{1}{2}\angle B + \angle CBP = 90°$$

$$\Rightarrow \quad \frac{1}{2}\angle B + \angle 1 = 90°$$

$$\Rightarrow \quad \angle 1 = 90° - \frac{1}{2}\angle B \qquad \cdots(1)$$




Similarly, $\angle 2 = 90° - \dfrac{1}{2}\angle C$

In $\Delta OBC$, we have $\angle 1 + \angle 2 + \angle BOC = 180°$

(Angle sum prop.)

$$\Rightarrow \left(90° - \frac{1}{2}\angle B\right) + \left(90° - \frac{1}{2}\angle C\right) + \angle BOC = 180°$$

$$\Rightarrow \angle BOC = \frac{1}{2}(\angle B + \angle C)$$

$$= \frac{1}{2}(\angle A + \angle B + \angle C) - \frac{1}{2}\angle A$$

$$= \frac{1}{2} \times 180° - \frac{1}{2}\angle A$$

$$\angle BOC = 90° - \frac{1}{2}\angle A.$$

**50.** **(a)** Join $B$ and $D$ and produce $BD$ to $E$

Then, $p + q = \beta$ and $s + t = x$

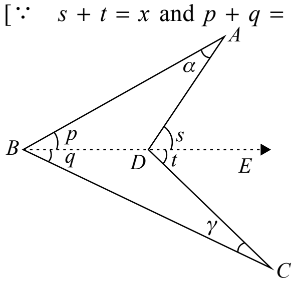
Now, $s = p + \alpha$ (Exterior angle of a $\Delta$ prop.)

Similarly, $t = q + \gamma$ (Exterior angle of a $\Delta$ prop.)

Adding, $s + t = p + q + \alpha + \gamma$

$x = \alpha + \beta - \gamma$

[$\because$ $s + t = x$ and $p + q = \beta$]




**51.** **(d)** Since $AM$ is the bisector of $\angle A$,

$$\therefore \angle MAB = \frac{1}{2}\angle A \qquad \cdots(1)$$

In rt-angled $\Delta ANB$, we have:

$\angle B + \angle NAB = 90° \Rightarrow \angle NAB = 90° - \angle B$ $\qquad \cdots(2)$

$$\therefore \angle MAN = \angle MAB - \angle NAB$$

$$= \frac{1}{2}\angle A - (90° - \angle B)$$

$$= \frac{1}{2}\angle A - 90° + \angle B$$

$$= \frac{1}{2}\angle A - \frac{1}{2}(\angle A + \angle B + \angle C) + \angle B$$

$$\left(\because \frac{1}{2}(\angle A + \angle B + \angle C) = 90°\right)$$

$$= \frac{1}{2}(\angle B - \angle C).$$

**52.** **(c)** $CE \parallel BA$ and $AC$ is the transversal

$\therefore \angle 4 = \angle 1$ (alt. int. $\angle s$)

Again, $CE \parallel BA$ and $BD$ is the transversal

$\therefore \angle 5 = \angle 2$ (corr. $\angle s$)

$\therefore \angle 4 + \angle 5 = \angle 1 + \angle 2$

$\therefore \angle ACD = \angle A + \angle B$.

**53.** **(a)** $\angle 1 = \angle A + \angle 5$ and

$\angle 2 = \angle A + \angle 6$ [Ext. angle prop. of a $\Delta$]

$\angle 1 + \angle 2 = 2\angle A + \angle 5 + \angle 6$

$= 2\angle A + (180° - \angle A) = \angle A + 180°$

The given question can be restated as the sum of two exterior angles exceeds $\angle A$ of the $\Delta ABC$ by 2 right angles.

**54.** **(c)** In $\Delta ABC$, $\angle ACE = \angle ABC + \angle BAC$

Similarly in $\Delta BCD$, $\angle BDC = \angle DCE - \angle DBC$

[Ext. angle prop. of a $\Delta$]

But $\angle DCE = \frac{1}{2}\angle ACE$ and

$$\frac{1}{2}\angle DBC = \frac{1}{2}\angle ABC$$

$$\text{Now, } \angle BDC = \angle DCE - \angle DBC$$

$$= \frac{1}{2}\angle ACE - \frac{1}{2}\angle ABC$$

$$= \frac{1}{2}(\angle ACE - \angle ABC)$$

$$= \frac{1}{2}(\angle ACE + \angle BAC - \angle ACE)$$

$$\therefore \angle BDC = \frac{1}{2}\angle BAC.$$

**55.** **(d)** In $\Delta BCE$, $BC = EC$, $\therefore \angle B = \angle BEC$

In $\Delta CDE$, $ED = EC$, $\therefore \angle ECD = \angle EDC$

and In $\Delta ADE$, $AD = ED$, $\therefore \angle AED = \angle A$

Now $\angle B = \angle BEC = \angle A + \angle ECD$

$= \angle A + \angle EDC = \angle A + \angle EAD + \angle AED$

$= \angle A + \angle A + \angle A = 3\angle A$

$$\therefore \frac{\angle B}{\angle A} = \frac{3}{1}$$

or, $\angle A : \angle B = 1 : 3$.

**56.** **(d)** In the rectangle $ABCD$.

$AB = CD$ and $AD = BC$.

Since the diagonals of a rectangle bisect each other,

$\therefore OA = OD$ i.e., $\angle ODA = \angle OAD$.

But, $\angle AOD = 44°$ (Vertically opposite angle to $\angle BOC$)

$$\therefore \angle OAD = \frac{1}{2}(180° - 44°) = \frac{1}{2}(136°) = 68°$$

Hence, $\angle OAD = 68°$

**57.** **(a)** $PQRS$ is a square

$SP = SR$ and $\angle S = 90°$

and $\angle SRP = \angle SPR = \frac{1}{2}(90°) = 45°$

Hence, $\angle SRP = 45°$.

**58.** **(d)** Since $AB = BC$

$$\therefore \angle BAC = \angle BCA = \frac{1}{2}(180° - 56°) = 62°$$

Also as $AB \parallel CD$ and $AC$ transversal

So $\angle BAC = 62° = \angle ACD$

(Alternate interior angles)

$\therefore \angle ACD = 62°$.

**59.** **(a)** Since $X$ and $Y$ are the mid-points of $AB$ and $DC$ respectively.

$\therefore \quad AX = \frac{1}{2}AB$ and $CY = \frac{1}{2}DC$

But $\therefore \quad AB = DC \quad \Rightarrow \quad \frac{1}{2}AB = \frac{1}{2}DC \quad \Rightarrow \quad AX = CY$

Also, $AB \parallel DC$ [$\because$ $ABCD$ is a parallelogram]

$\Rightarrow \quad AX \parallel YC$

Thus, in quadrilateral $AXCY$,

$AX \parallel YC$ and $AX = YC$

Hence, quad, $AXCY$ is a parallelogram.

**60.** **(c)** Proceeding as in $Q$. No. 4, we can prove that $AXCY$ is a parallelogram

Similarly, $BXDY$ is a parallelogram.

Now, $AXCY$ is a parallelogram

$\Rightarrow \quad AY \parallel CX$

[$\because$ Opposite sides of a parallelogram are parallel]

$\Rightarrow \quad PY \parallel QX$ $\cdots(1)$

Also, $BXDY$ is a parallelogram

$\Rightarrow \quad DX \parallel BY$

[$\because$ Opposite sides of a parallelogram are parallel]

$\Rightarrow \quad PX \parallel QY$ $\cdots(2)$

Thus, in a quadrilateral $PXQY$, we have

$PY \parallel QX$ and $PX \parallel QY$ [From (i) and (ii)]

$\Rightarrow \quad PXQY$ is a parallelogram.

**61.** **(c)** In $\Delta ARB$, $P$ is the mid-point of $AB$ and $PD \parallel BR$.

$\Rightarrow \quad D$ is the mid-point of $AR$.

$\because$ $ABCD$ is a parallelogram

$\Rightarrow \quad DC \parallel AB \quad \Rightarrow \quad DQ \parallel AB$

Thus, in $\Delta RAB$, $D$ is the mid-point of $AR$ and $DQ \parallel AB$.

$\therefore \quad Q$ is the mid-point of $RB \quad \Rightarrow \quad BR = 2BQ$.

**62.** **(d)** $ABCD$ is a trapezium in which $AB \parallel DC$ and $M$, $N$ are the mid-points of $AD$ and $BC$.

Hence, $MN \parallel AB$ and $MN \parallel DC$.

In $\Delta ACB$,

ON passes through the mid-point $N$ of $BC$ and $ON \parallel AB$

$\therefore \quad ON = \frac{1}{2}AB = \frac{1}{2}(12 \text{ cm}) = 6 \text{ cm}$

But $MO = MN - ON = (14 - 6)$ cm $= 8$ cm

Again $MO$ passes through the mid-point $M$ of $AD$ and $MO \parallel DC$

$\therefore \quad MO = \frac{1}{2}DC = \frac{1}{2}CD$

Hence, $CD = 2(MO) = 2(8) = 16$ cm.

**63.** **(a)** Consider $\Delta$s $PSX$ and $QRY$, in which $\angle X = \angle Y = 90°$

[$\because$ $PX \perp SR$ and $QY \perp SR$.]

and $SX = RY$

[$\because$ $SX = SY - XY$ and $RY = SY - SR = SY - PQ = SY - XY$]

and $PS = QR$ [Sides of a parallelogram]

$\therefore \quad \Delta PSX \cong \Delta QRY$ [R.H.S. axiom]

$\therefore \quad PX = QY$

[Corresponding parts of congruent $\Delta$s are congruent]

**64.** **(c)** $ABC$ is a $\Delta$ and $P$, $Q$, $R$ are the mid-points of sides $BC$, $CA$ and $AB$ resp.

$\therefore \quad PQ \parallel AB$

and $PQ = \frac{1}{2}AB = \frac{1}{2}(30) = 15$ cm.

Similarly, $RP \parallel AC$

and $RP = \frac{1}{2}AC = \frac{1}{2}(21) = 10.5$ cm.

$\therefore \quad$ Perimeter of $ARPQ = (AR + RP + PQ + QA)$ cm.

$= (15.0 + 10.5 + 15.0 + 10.5)$ cm.

$= 51$ cm.

**65.** (a) $ABCD$ is a parallelogram.

$\Rightarrow \quad AD = BC$ and $AD \parallel BC$.

$\Rightarrow \quad \frac{1}{3}AD = \frac{1}{2}BC$ and $AD \parallel BC$.

$\Rightarrow \quad AP = CQ$ and $AP \parallel CQ$.

Thus, $APCQ$ is a quad. Such that one pair of opposite side $AP$ and $CQ$ are parallel and equal.

Hence, $APCQ$ is a parallelogram.

**66.** (a) In a parallelogram $ABCD$,

$\angle A + \angle D = 180°$

Let, $\angle D = x°$, $\angle A = 2x - 30°$

$\therefore \quad (2x° - 30°) + x° = 180°$

$\Rightarrow \quad 3x° = 180° + 30°$

$\Rightarrow \quad 3x° = 210°$ or $x = \frac{210°}{3}$

$\therefore \quad x° = 70°$

$\therefore \quad \angle D = 70° = \angle B$

and $\angle A = 2x - 30° = 110° = \angle C$.

**67.** (a) In $\Delta BDC$, $Q$ and $R$ are the mid-points of $BD$ and $CD$ respectively.

$\therefore \quad QR \parallel BS$ and $QR = \frac{1}{2}BC$.

Similarly, $PS \parallel BC$ and $PS = \frac{1}{2}BC$.

$\therefore \quad PS \parallel QR$ and $PS = QR$ $\left[\text{each equal to} \frac{1}{2}BC\right]$.

Similarly $PQ \parallel SR$ and $PQ = SR$ $\left[\text{each equal to} \frac{1}{2}AD\right]$.

$\therefore \quad PS = QR = SR = PQ$ [$\because$ $AD = BC$]

Hence, $PQRS$ is a rhombus.

**68.** **(c)** Since $AB \parallel DC$ and transversal $AC$ cuts them at $A$ and $C$ cresp.

$\therefore \quad \angle 1 = \angle 2$ $\cdots(1)$

[$\because$ Alternate angles are equal.]

Now, in $\Delta APR$ and $\Delta DPC$, $\angle 1 = \angle 2$

$AP = CP$ [$\because$ $P$ is the mid-point of $AC$]

And $\angle 3 = \angle 4$. [Vertically opposite angles]

So, $\Delta APR \cong \Delta DPC[ASA]$.

$\Rightarrow$ $AR = DC$ and $PR = DP$ $\cdots(2)$

Again, $P$ and $Q$ are the mid-points of sides $DR$ and $DB$ respectively in $\Delta DRB$.

$\therefore$ $PQ = \frac{1}{2}RB = \frac{1}{2}(AB - AR)$. [$\because$ $AR = DC$].

$\therefore$ $PQ = \frac{1}{2}(AB - DC)$.

**69.** **(b)** $AB \parallel DC$ and $EC$ cuts them

$\Rightarrow$ $\angle BEC = \angle ECD$

$\Rightarrow$ $\angle BEC = \angle ECB$ [$\because$ $\angle ECD = \angle ECB$].

$\Rightarrow$ $EB = BC$ $\Rightarrow$ $AE = AD$.

Now, $AE = AD$ $\Rightarrow$ $\angle ADE = \angle AED$

$\Rightarrow$ $\angle ADE = \angle EDC$

[$\because$ Alternate Int. angles].

$\therefore$ $DE$ bisects $\angle ADC$

Again, $\angle ADC + \angle BCD = 180°$ [Co. Int. angles].

$\Rightarrow$ $\frac{1}{2}\angle ADC + \frac{1}{2}\angle BCD = 90°$

$\Rightarrow$ $\angle EDC + \angle DCE = 90°$

But, $\angle EDC + \angle DEC + \angle DCE = 180°$

[$\because$ sum of the $\angle$s of a $\Delta$ is 180°]

$\therefore$ $\angle DEC = 180 - 90°$

$\therefore$ $\angle DEC = 90°$.

**70.** **(c)** $100° + 98° + 92° + x° = 360$

(sum of the angles of a quad)

$\because$ $290° + x = 360$ or $x = 360° - 290° = 70°$

**71.** **(d)** Let, the measure of each angle be $x°$. Then, sum of all the angles = $6x°$

We have,

Sum of all interior angle of a polygon = $(2n - 4)$ right. angle

$\therefore$ Sum of all interior angles of a hexagon

= $(2 \times 6 - 4)$ right angles

= 8 right angle = 720°

$6x° = 720°$ or $x = 120°$.

**72.** **(d)** Let there be $n$ sides of the polygon. Then, each interior angles is of measure $\left(\frac{2n-4}{n} \times 90\right)°$

$\therefore \frac{2n-4}{n} \times 90 = 108 \Rightarrow 180n - 360 = 108n$

$\Rightarrow$ $72n - 360°$ $\Rightarrow$ $n = 5$

SO, the polygon has 5 sides.

**73.** **(a)** We know the no. of diagonals of a polygon of n sides is $\frac{n(n-1)}{2} - n$

$\therefore$ for $a$ hexagon, $n = 6$

$\frac{6(6-1)}{2} - 6 = \frac{6 \times 5}{2} - 6 = 15 - 6 = 9.$

**74.** **(b)** Since the no. of diagonals of a polygon of $n$ sides is $\frac{n(n-1)}{2} - n$

$\therefore$ $\frac{n(n-1)}{2} - n = 27 \Rightarrow n^2 - n - 2n = 54$

$\because$ $n^2 - 3n - 54 = 0$

$\Rightarrow$ $(n - 9)(n + 6) = 0$

$\Rightarrow$ $n = 9$ or $n = -6$

$\therefore$ $n = 9$.

**75.** **(c)** One angle of the pentagon is 140°

Since the remaining angles are in the ratio 1:2:3:4, $\therefore$, let the remaining angles be $x°$, $(2x)°$, $(3x)°$ and $(4x)°$

But the sum of interior angles of a pentagon $(2.5 - 4) \times 90 = 6 \times 90° = 540°$

$\therefore$ $140 + x + 2x + 3x + 4x = 540$

$\Rightarrow$ $10x = 400$ $\Rightarrow$ $x = 40$

$\therefore$ The angles of the pentagon are 140°, 40°, 80°,120° and 160°

Hence the size of the greatest angle = 160°.

**76.** **(b)** Let there be $n$ sides of the polygon. Then each exterior angle $= \left(\frac{360}{n}\right)°$ and each interior angle $= \left(\frac{2n-4}{n} \times 90\right)°$

We have

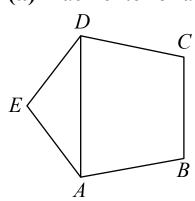
Exterior angle $= \frac{1}{3}$ (interior angle)

$\Rightarrow$ $\frac{360}{n} = \frac{1}{3}\left(\frac{2n-4}{n} \times 90\right)$

$\Rightarrow$ $360 = 60(n - 2)$ $\Rightarrow$ $6 = n - 2$ $\Rightarrow$ $n = 8$

Thus the polygon has 8 sides.

**77.** **(a)** Each exterior angle of a regular octagon $= \frac{360°}{8} = 45°$




Each exterior angle of a regular octagon

= (180 − 45°) = 135°

$\therefore$ Required ratio $= \frac{135}{45} = 3:1.$

**78.** **(d)** Here number of sides = 5

$\therefore$ Each interior angle $= \left(\frac{2n-4}{n}\right)$ right. angles

$= \frac{2 \times 5 - 4}{5} \times 90° = 108°$

In $\Delta AEA$, $\angle AED = 108°$ and $AE = ED$

$\therefore \quad \angle EDA = \angle EAD = \dfrac{180 - 108}{2} = 36°$

$\therefore \quad \angle ADC = \angle EDC - \angle EDA = (108 - 36)° = 72°$

$\therefore \quad \dfrac{\angle ADE}{\angle ADC} = \dfrac{36}{72} = \dfrac{1}{2}.$

**79.** **(c)** Each ext. angle of $(n - 1)$ sided regular polygon $= \left(\dfrac{360}{n-1}\right)^{\circ}$ and each ext. angle of (n + 2) sided regular

polygon $= \left(\dfrac{360}{n-2}\right)^{\circ}$

According to the question, $\dfrac{360}{n-2} = 6$

(Since greater is the number of sides, smaller is the value of each ext. angle)

$\Rightarrow \quad 360\,(n + 2) - 360\,(n - 1) = 6\,(n - 1)(n + 2)$

$\Rightarrow \quad 60(n + 2 - n + 1) = n^2 + n - 2$

$\Rightarrow \quad 180 = n^2 + n - 2 \Rightarrow \quad n^2 + n - 182 = 0$

$\Rightarrow \quad (n + 14)\,(n - 13) = 0$

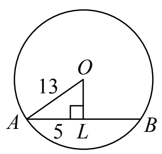
$\Rightarrow \quad n = -14$ or $n = 13$

$\Rightarrow \quad n = 13 \qquad (\because \ n$ cannot be negative)

**80.** **(c)** $OA = 13$ cm, $AB = 10$ cm

From $O$, draw $OL \quad AB$

We know that the perpendicular from the centre of a circle to a chord bisects the chord.




$\therefore \quad AL = \dfrac{1}{2} AB = 5$ cm

In right $\Delta OLA$,

$OA^2 = OL^2 + LA^2$ (Pythagoras them.)

$169 - 25 = OL^2$

$OL\sqrt{144} = 12$ cm.

**81.** **(a)** Since ABCD is a cyclic quadrilateral

$\therefore \quad \angle ADC + \angle ABC = 180°$

$\Rightarrow \quad 130° + \angle ABC = 180°$

$\Rightarrow \quad \angle ABC = 50°$

Also, $\angle ACB = 90°$

$\therefore$ In $\Delta ABC$,

$\angle ACB + \angle ABC + \angle CAB = 180°$ (ASP)

$\Rightarrow \quad 90° + 50° + \angle CAB = 180° \quad \Rightarrow \quad \angle CAB = 40°.$

**82.** **(d)** $\angle AOC = 2\,\angle APC$

$\therefore \quad \angle APC = 50°$

Also, $ABCP$ is a cyclic quad.

$\therefore \quad \angle ABC = \angle APC$

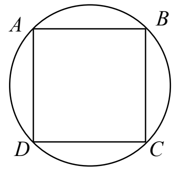
$\therefore \quad \angle ABC = 50°$

$\therefore \quad \angle CBD = 180 - 50 = 130°.$

**83.** **(c)** $BD = DA = DC$

$\therefore \quad BD = 3$ cm.

**84.** **(c)** A cyclic quadrilateral whose opposite angles are equal is a rectangle




$\Rightarrow$ In a cyclic quad.

$\angle A + \angle C = 180°$

But $\angle A = \angle C$

$\therefore \quad \angle A = \angle C = 90°$

Similarly, $\angle B = \angle D = 90°$ and hence $ABCD$ is a rectangle.

**85.** **(b)** Since $ST$ is a diameter

$\therefore \quad \angle TRS = 90°$

Also, $\angle TRQ = \angle TSR$ (angles in alternate segments.)

$\therefore \quad \angle TSR = 40°$

Hence, $\angle STR = 50°$.

**86.** **(d)** $\angle TPQ = \angle PAQ = 70°$

($\angle s$ in the alternate segments)

$TP = TQ \Rightarrow \angle TQP = \angle TPQ = 70°$

$\therefore \quad \angle PTQ = 180° - 70° - 70° = 40°.$

**87.** **(a)** $PA = PB$

$\therefore \quad \angle PAB = \angle PBA$

Also, $\angle PAB + \angle PBA = 180° - \angle APB$

$180° - 60 = 120°$

$\therefore \quad \angle PAB = \angle PBA = 60$

i.e., $\Delta PAB$ is an equilateral triangle

$\therefore \quad AB = 8$ cm.

**88.** **(c)** $OA = OB \Rightarrow \angle OAB = \angle OBA = 32°$

$\therefore \quad \angle OAB + \angle OBA = 32° + 32° = 64°$

$\therefore \quad \angle AOB = 180 - 64 = 116°$

$\Rightarrow \quad \angle ACB = \dfrac{1}{2} \angle AOB = 58°$

(Degree Measure Thm.)

Also, $\angle ACB = \angle BAS$

(angles in alternate segments)

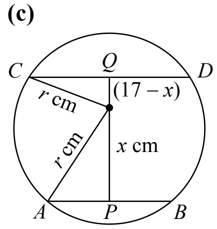
$\therefore \quad \angle BAS = x = 58°$

**89.** **(c)** Since $ABCD$ is a circumscribed quadrilateral

$\therefore \quad AB + CD = BC + AD \Rightarrow 6 + 4 = 7 + AD$

$\therefore \quad AD = 10 - 7 = 3$cm.

**90.** **(c)**



In right Δs $OAP$ and $OQC$, we have

$OA^2 = OP^2 + AP^2$ and $OC^2 = OQ^2 + CQ^2$

$r^2 = x^2 + 5^2$ and $r^2 = (17 - x)^2 + 12^2$

$\Rightarrow$ $x^2 + 25 = 289 + x^2 - 34x + 144$

$\Rightarrow$ $34x = 408 \Rightarrow x = 12$ cm

$\therefore$ $r^2 = 122 + 52 = 169$

$\therefore$ $r = 13$ cm

**91.** **(a)** If two circle touch internally then distance between their centres is equal to the difference of their radii.

$\therefore$ $AB = (5 - 3)$ cm $= 2$ cm

Also, the common chord $PQ$ is the ^ bisector of $AB$

$\therefore$ $AC = CB = 1$ cm

In right. $\Delta ACP$, we have

$AP^2 = AC^2 + CP^2$

$\Rightarrow$ $25 - 1 = CP^2$

$\therefore$ $CP = \sqrt{24}$ cm

Hence, $PQ = 2CP = 2\sqrt{24} = 4\sqrt{6}$ cm.

**92.** **(b)** Since $PT$ is a tangent and $PCB$ is a secant to the circle

$\therefore$ $PC \times PB = PT^2$

$\Rightarrow$ $3 \times PB = 62$ $\Rightarrow$ $PB = 12$ cm

$\Rightarrow$ $3 + BC = 12$ $\Rightarrow$ $BC = 9$ cm

$\therefore$ radius of the circle $= \dfrac{1}{2}BC = 4.5\,\text{cm}$

**93.** **(d)** Let $AB = 9$ cm, $BC = 7$ cm and $CA = 6$ cm

The, $x + y = 9$ cm

$y + z = 7$ cm

$z + x = 6$ cm

Adding, we get $2(x + y + z) = 22°$

$\Rightarrow$ $x + y + z = 11$

$\therefore$ $z = (11 - 9) = 2$, $x = (11 - 7) = 4$

and $y = (11 - 6) = 5$

Hence, the radii of the given circles are 4 cm., 5 cm and 2 cm respectively

**94.** **(a)** $OR = OS$, $OR \perp DR$ and $OS \perp DS$

$\therefore$ $ORDS$ is a square

Also, $BP = BQ$, $CQ = CR$ and $DR = DS$

$\therefore$ $BQ = BP = 27$ cm $\Rightarrow$ $BC - CQ = 27$ cm

$\Rightarrow$ $38 - CQ = 27$ cm

$\Rightarrow$ $CQ = 11$ cm

$\Rightarrow$ $CR = 11$ cm

$\Rightarrow$ $CD - DR = 11$

$\Rightarrow$ $25 - DR = 11$

$\Rightarrow$ $DR = 14$ cm

$\Rightarrow$ $r = 14$ cm.

**95.** **(d)** Since $AD$ is the tangent to the circle from $A$ and $APB$ is a secant

$\therefore$ $AP \times AB = AD^2$

$\Rightarrow$ $AP \times AB = \left(\dfrac{1}{2}AC\right)^2 = \dfrac{1}{4}AC^2$

$\Rightarrow$ $AP \times AB = \dfrac{1}{4}AB^2$ $(\because AC = AB)$

$\Rightarrow$ $AP = \dfrac{1}{4}AB.$

**96.** **(c)** Draw $OD \perp AB$,

$OE \perp BC$ and $OF \perp AC$.

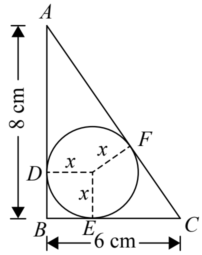
Let $OD = OE = OF = x$

Then, $AF = AD = (8 - x)$; $CF = CE = (6 - x)$

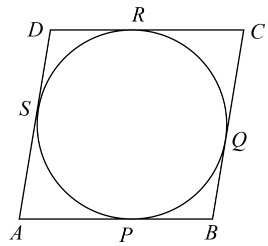
$\therefore$ $AC = \sqrt{AB^2 + BC^2} = \sqrt{8^2 + 6^2} = 10\,\text{cm}$

So, $AC = AF + FC \Rightarrow (8 - x) + (6 - x) = 10$

or, $x = 2$.




**97.** **(b)** We have,




$AP = AS$

$BP = BQ$

$CR = CQ$

$DR = DS$

$\therefore$ $AB + CD = AP + BP + CR + DR$

$= AS + BQ + CQ + DS$

$= (AS + DS) + (BQ + CQ)$

$= AD + BC$

Since, $AB = CD$ and $AD = BC$

($\because$ opposite sides of a $\|_{gm}$ are equal)

$\Rightarrow$ $AB = AD$

$\therefore$ $CD = AB = AD = BC$

Hence $ABCD$ is a rhombus.

**98.** **(d)** $\angle BOD = 180 - \angle AOD = 180 - 140 = 40°$

$OB = OD$ $\Rightarrow$ $\angle OBD = \angle ODB = 70°$

Also, $\angle CAB + \angle BCD = 180$ $[\because$ $ABCD$ is cyclic$]$

$\Rightarrow$ $50° + 70° + \angle ODC = 180$ $\Rightarrow$ $\angle ODC = 60°$

$\therefore$ $\angle EDB = 180° - (60° + 70°) = 50°$

**99. (a)** In $\Delta ADP$

Ext $\angle ADC$ = Interior ($\angle A + \angle P$)

$= 40° + 20° =$

$\therefore\ \angle ABC = \angle ADC = 60°$

Since $AD$ is the diameter

$\Rightarrow\ \angle ABD = 90°$

$\therefore\ \angle DBA = \angle ABD - \angle ABC = 90° - 60° = 30°$

**100. (c)** $\angle QSR = \angle QTR \dfrac{z}{2}$

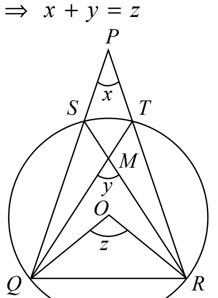
$\therefore\ \angle PSM = \angle PTM = 180° = \dfrac{z}{2}$

Also, $\angle SMR = y$

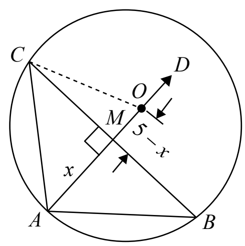
$\therefore$ In quadrilateral PSMT

$$180 - \frac{z}{2} + 180 - \frac{z}{2} + y + x = 360.$$

$\Rightarrow\ x + y = z$




**101. (a)** Let, $AD$ be the bisector of $BC$ and passes through the centre. Join $CO$




Also, $BM = CM$

In right $\Delta AMC$, we have $CM^2 = 36 - x^2$ $\cdots(1)$

Also, In right $\Delta OMC$

$CM^2 = 25 - (5 - x)2$ $\cdots(2)$

From (1) and (2),

$36 - x = 25 - (25 + x^2 - 10x)$

$10x = 36,\ x = 3.6$ cm

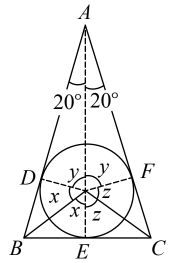
$$CM = \sqrt{36 - (3.6)^2} = \sqrt{23.04}\ \text{cm} = 4.8\ \text{cm}$$

and $BC = 2CM = 2 \times 4.8 = 9.6$ cm.

**102. (d)** $AO$ is joined

Since the circle is the incircle for $\Delta ABC$, $AO$, $BO$, and $CO$ are the angle bisectors of $\angle A$, $\angle B$ and $\angle C$ respectively

$$\angle DAO = \angle FAO = \frac{1}{2}\angle BAC = 20°$$




$\angle OFA = 90°$

In $\Delta AOF$, $\angle AOF = \angle AOD = 70° = y$

From the figure

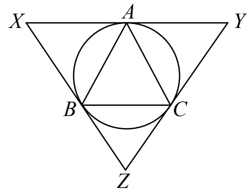
$x + x + y + y + z + z = 360°$

$\Rightarrow\ 2(x + z) + 2y = 360°$

$\Rightarrow\ 2 \times \angle BOC = 140° = 360°$

$\therefore\ \angle BCO = 110°.$

**103. (b)** Let, $xy$, $yz$, and $zx$ be the tangents to the circle at the vertices of an equilateral $\Delta ABC$




Since $XY$ is as tangent to the circle at the point $A$,

$\therefore\ \angle XAB = \angle ACB = 60°$

Similarly, $\angle ABX = 60°$

$\therefore$ In $\Delta AXB$, $\angle AXB = 180 - (60° + 60°) = 60°$

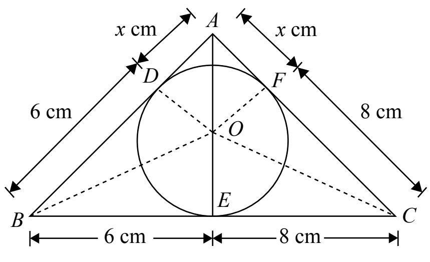
Similarly it can be shown that $\angle Y = 60°$ and $\angle Z = 60°$

$\therefore\ \Delta XYZ$ is an equilateral $D$

**104. (c)** $BD = BE = 6$ cm and $AB = (s + 6$ cm)

$BC = (6 + 8)$ cm $= 14$ cm

$AC = (x + 8)$ cm




Hence, $S = \dfrac{a + b + c}{2} = \dfrac{2x + 28}{2} = x + 14$

Now ar. ($\Delta ABC$) = ar. ($\Delta OBC$)

+ ar. ($\Delta OCA$) + ar. ($\Delta OAB$)

$$\Rightarrow\ \sqrt{S(S-a)(S-b)(S-c)} = \frac{1}{2}\angle OE \times BC$$

$$+\frac{1}{2}OF \times AC + \frac{1}{2} \times OD \times AB$$

$\Rightarrow \quad \sqrt{(x+14)(x)(6)(8)} = \frac{1}{2}\times 4\times 14$

$+\frac{1}{2}\times 4\times(x+8)+\frac{1}{2}\times 4x(6+x)$

$\Rightarrow \quad 4\sqrt{3x^2+42x} = 4(14+x)$

$\Rightarrow$ $2x^2 - 14x - 196 = 0$

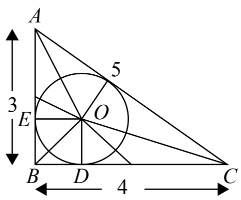
or, $x^2 - 7x - 98 = 0$

$\therefore$ $x = 7$, $x = -14$ (not possible)

$\therefore$ Shortest side = 6 + 7 = 14 = 13 cm.

## Exercise-2
## (Based on Memory)

**1.** **(c)** If the in circle of a triangle *ABC* touches *BC* at *D*, then $|BD - CD| = |AB - AC|$




In our case, $AC = 5$, $AB = 3$

$\Rightarrow$ $AC - AB = 2$

$\therefore$ $CD - BD = 2$

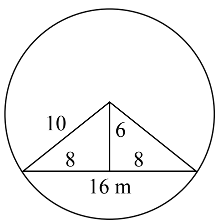
In our case, $BC = 4$

$\Rightarrow$ $BD + BD = 4$ and $- BD + DC = 22$

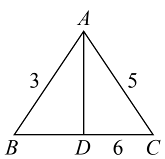
$\Rightarrow$ $CD = 3$

$\Rightarrow$ $BD = 1 = OE$ = Radius of the in circle.

**4.** **(c)**




**6.** **(b)**




$BD{:}DC = 3{:}5$

$\therefore$ Divided $BC = 6$ in the ratio 3:5

$\Rightarrow$ $BD = 2.25$, $CD = 3.75$.

**7.** **(a)** $x + y + (y + 20) = 5 \quad \Rightarrow \quad x + 2y = 160$

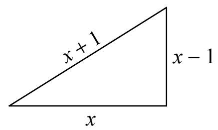
$4x - y = 10 \quad \Rightarrow \quad y = 70, x = 20$

$\therefore$ The angles of the triangle are 20°, 70°, 90°.

**8.** **(a)** Let, $(x + 1)$ be the hypotenuse

$\therefore$ $(x + 1)^2 = x^2 + (x + 1)^2 \quad \Rightarrow \quad x = 4$

$\therefore$ Hypotenuse = 5



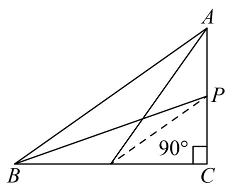

**10.** **(b)** $AQ^2 = AC^2 + QC^2$

$BP^2 = BC^2 + CP^2$

$AQ^2 + BP^2 = (AC^2 + BC^2) + (QC^2 + CP^2) = AB^2 + PQ^2$

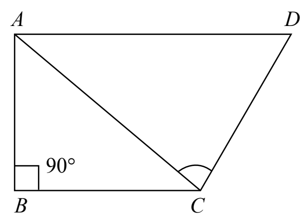
$= AB^2 + \left(\frac{1}{2}AB\right)^2 \quad \left[\because \; PQ = \frac{1}{2}AB\right]$

$= \frac{5}{4}AB^2 = 4(AQ^2 + BP^2) = 5AB^2$

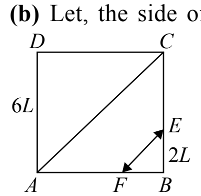



**11.** **(a)** $AB^2 + BC^2 + CD^2 = AC^2 + CD^2 = AD^2$

$\Rightarrow$ $\angle ACD = 90°$




**12.** **(b)** Let, the side of the square be $6L$




Then $\frac{1}{2}\times 3L\times 2L = 108 \quad \Rightarrow \quad L = 6$

$\therefore$ Side of the square = 60 m

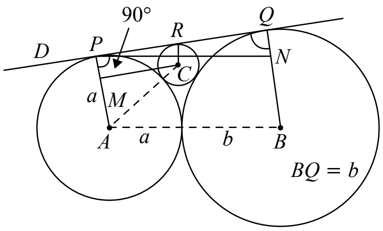
$\Rightarrow$ $AC^2 = AD^2 + DC^2 = (36)^2 + (36)^2 = 2 \times (36)^2$

$\Rightarrow$ AC = 36√2.

**13.** **(d)** Measure of the angle will not change.

**14. (c)** $PR = MC = \sqrt{AC^2 - AM^2}$

$\therefore \quad \sqrt{(a+c)^2 - (a-c)^2} = 2\sqrt{ac}$




Similarly, $QR = 2\sqrt{ac}$

Now, $PQ = PR + RQ = 2\sqrt{ac} + 2\sqrt{bc}$ $\cdots(1)$

Draw $PN$ Parallel to $AB$

$\therefore \quad PN = AB = a + b,$

$QN = BQ - BN = b - a$

$\therefore \quad PQ^2 = PN^2 - QN^2 = (a + b)^2 - (a - b) = 4ab$

$\Rightarrow \quad PQ = 2\sqrt{ab}$ $\cdots(2)$

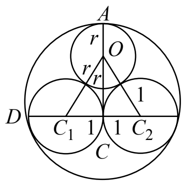
$\therefore$ From (i) and (ii)

$\Rightarrow \quad \dfrac{1}{\sqrt{c}} = \dfrac{1}{\sqrt{a}} + \dfrac{1}{\sqrt{b}}.$

**15. (c)** $CC_1 = 1$, $OC1 = 1 + \text{r}$

$OC = AC - AO = CD - AO = 2 - \text{r}$

[$AC$ and $CD$ are the radii of the bigger circle]




$\therefore \quad CO_1^2 = CC_1^2 + OC^2$

$\Rightarrow \quad (1 + r)^2 = 1^2 + (2 + r)^2$

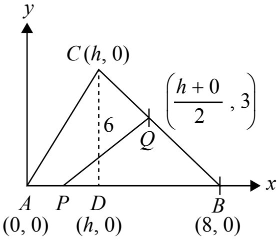
$\Rightarrow \quad r = \dfrac{2}{3}.$

**16. (d)** Area of ($\Delta PRS + \Delta PQR$)

$= \dfrac{1}{2} AD(AP + PB)$

$= \dfrac{1}{2} AD \times AB = 8 \text{ cm}^2.$

**17. (d)** Let, $AD = h$ coordinates of $P$ are $\left(\dfrac{h}{2}, 0\right)$.




$CD = 6$

$PQ = \sqrt{\left(\dfrac{h}{2} - \left(\dfrac{h+8}{2}\right)^2\right) + (0.3)^2} = \sqrt{16+9} = 5.$

**18. (d)** Let, $OA = OC = \text{Radius} = x$

$\therefore \quad AO^2 + OC^2 = AC^2 \;\Rightarrow\; 2x^2 = 98 \;\Rightarrow\; x = 7$

$\therefore \quad \text{Area of the circle} = \pi x^2 = \dfrac{22}{7} \times 49 = 154 \text{ cm}^2.$

**20. (b)** Using the sine fomula, we have

$\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

$\therefore \quad \dfrac{\sin 40°}{BD} = \dfrac{\sin(40° + C)}{6}$

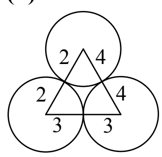
$\Rightarrow \quad \dfrac{\sin 40°}{B - DC} = \dfrac{\sin[180 - (40 + C)]}{6} = \dfrac{\sin(140 - C)}{6}$ $\cdots(1)$

Also $\quad \dfrac{\sin 40°}{DC} = \dfrac{\sin(140° - C)}{9}$ $\cdots(2)$

$\therefore$ From (i) and (ii) give

$\dfrac{DC}{8 - DC} = \dfrac{9}{6} = \dfrac{3}{2} \;\Rightarrow\; 5DC = 24 \;\Rightarrow\; DC = 4.8.$

**23. (d)**




Sum of radii = 2 + 3 + 4 = 9 cm.

**27. (b)** The sum of the interior angles of a polygon of $n$ side $= (2n - 4) \times \dfrac{\pi}{2}$

$\therefore \quad (2n + 4) \times \dfrac{\pi}{2} = 1620 \;\Rightarrow\; n = 11.$

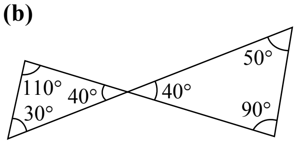
**28. (c)** Let, $n$ the number of sides of the polygon.

$\therefore$ Interior angle = 8 × Exterior angle.

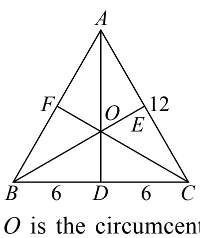
$\Rightarrow \quad \dfrac{(2n-4) \times \dfrac{\pi}{2}}{n} = 8 \times \dfrac{2\pi}{n}$

$\Rightarrow \quad n = 18.$

**33. (b)**




**36. (c)** Circumcircle of a triangle is the point of intersection of the perpendicular bisectors of the sides of the triangle.




$O$ is the circumcentre of the $\Delta ABC$, whose sides

$AB = BC = CA = 12$ cm

$\therefore$ From $\Delta ADC$

$$AC^2 = AD^2 + CD^2 \Rightarrow AD = \sqrt{(12)^2 - 6^2} = 6\sqrt{3}$$

Since, triangle is equilateral, therefore circumcentre = centroid

$\therefore$ $AO{:}OD = 2{:}1$

i.e., $AO = 4\sqrt{3}$,

$OD = 2\sqrt{3}$ $[\because AD = 6\sqrt{3}]$

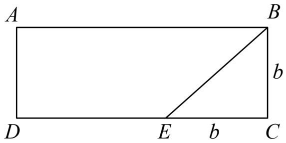
$\therefore$ Radius of the circumcircle

$= 4\sqrt{3} = OA = OB = OC$.

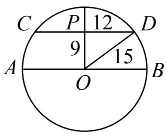
**37.** **(a)** Area of $\Delta BCE = \frac{1}{2} \times b \times b \Rightarrow b^2 = 28$

Area of rectangle $ABCD = (DE + EC) \times b$

$= 4EC \times b = 4b^2 = 112$.

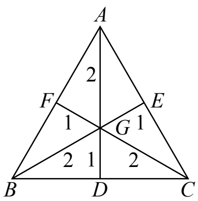



**43.** **(c)** $OP$ is perpendicular from the centre of the circle on the chord $CD$.




$OP^2 \sqrt{(15)^2 (12)^2} = 9$ cm.

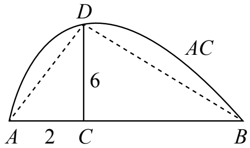
**44.** **(c)**




**45.** **(c)** The sum of the internal angles of a polygon of n sides = $(n - 2) \times 180°$

If $n = 7$, then the sum of the interior angles of the polygon $= (7 - 2) \times 180° = 900°$.

**46.** **(b)**




$CD^2 = AC \times CB$

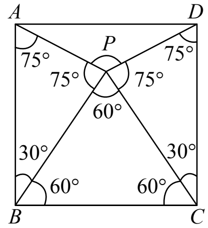
$(6)2 = 2 \times CB$

$CB = 18$

$AB = AC + CB = 18 + 2 = 20$

Area of semicircle $= \frac{1}{2}\pi r^2 = \frac{1}{2}\pi \times (10)^2 = 50\pi$ cm$^2$

**47.** **(e)** $\Delta BPC$ is an equilateral triangle




$\therefore$ $<CPD = <CDP = 75°$

Similarly $<BAP = <BPA = 75°$

Hence, $<APD = 360° - (75° + 75° + 60°)$

$= 360° - 210° = 150°$

**48.** **(b)** The sum of an angles of the quadrilateral = 360°

$2x + 4x + 7x + 5x = 360°$

$18x = 360°$

$x = 20°$

Smallest angle of the quadrilateral

$= 2 \times 20° = 40°$

According to question.

Smallest angle of the quadrilateral

= Smallest angle of a triangle

$\therefore$ Smallest angle of triangle = 40°

And its twice = 80°

Remaining angle of a triangle

$= 180° - (40° + 80°) = 60°$

So, the angles of triangle will be 40°, 60° and 80°

$\therefore$ Second largest angle = 60°

**49.** **(d)** Suppose $\angle A = x°$

$\angle B = x + 26$

$$\angle C = \frac{x + 26}{2} = \frac{x}{2} + 13$$

$$\angle D = \frac{x}{2} + 3$$

$\therefore$ $x + x + 26 + \frac{x}{2} + 13 + \frac{x}{2} + 3 = 360°$

$3x + 42 = 360° \left(\because \frac{x}{2} + \frac{x}{2} = x\right)$

$3x = 318°$

$x = 106°$

So, the angle $A = 106°$

**50.** **(c)** $3x + 4x + 6x + 5x = 360$

$x = 20°$

Largest angle of quadrilateral $= 6x$

$= 6 \times 20 = 120°$

Smaller angle of parallelogram

$= 120 \times \frac{2}{3} = 80°$

So the adjacent angle = 100°

**51.** **(d)** Suppose adjacent angle of parallelogram be $2x°$ and $3x°$.

Then, according to theorem, $2x° + 3x° = 180°$

$\Rightarrow$ $5x° = 180°$

$\Rightarrow \quad x° = \dfrac{180°}{5} = 36°$

Smaller angle of parallelogram = 2 × 36° = 72°

Smaller angle of quadrilateral = 36°

∴ Highest angle = 4 × 36° = 144°

Hence, required sum of angles = 144° + 36° = 180°

**52.** **(c)** An angle of a triangle

$= \dfrac{2}{3} \times 180° = 120°$

Remaining 180° – 120° = 60° is the ratio of 5:7.

So, $5x + 7x = 60$

$12x = 60$

$x = 5$

So, angles are 5 × 5 = 25°

and 7 × 5 = 35° and 120°

So, value of second largest angle of triangle is 35°.

**53.** **(b)** Let, the angles of the quadrilateral be $3x$, $4x$, $5x$ and $6x$, respectively.

Then, $3x + 4x + 5x + 6x = 360°$

$\Rightarrow \quad 18x = 360°$

$\Rightarrow \quad x = 20°$

∴ Smallest angle of the triangle

$= 3 \times 20 \times \dfrac{2}{3} = 40°$

∴ Largest angle of the triangle

= 40° × 2 = 80°

∴ Second largest angle of the triangle

= 180° – (40° + 80°) = 60°

and largest angle of the quadrilateral = $6x$

= 6 × 20° = 120°

Hence, required sum

= 60° + 12° = 180°

**54.** **(d)** Largest angle:second largest angle = 3:2

Smallest angle = $(3x + 2x)\dfrac{20}{100} = x$

Sum of three angles = 180°

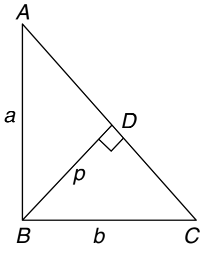
$3x + 2x + x = 180°$

$x = 30°$

Smallest + second largest angle

$x + 2x = 3x = 3 \times 30° = 90°$

**55.** **(c)**




$BD \perp AC$

$AB \perp BC$

Hypotenuse of $\Delta ABC = \sqrt{AB^2 + BC^2} = \sqrt{a^2 - b^2}$

Area of $\Delta ABC = \dfrac{1}{2} \times AB \times BC = \dfrac{1}{2} \times AC \times BD$

$\Rightarrow \quad AB \times BC = AC \times BD$

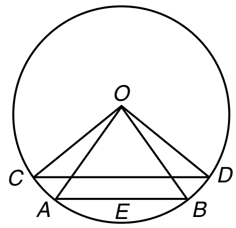
$\Rightarrow \quad ab = \sqrt{a^2 + b^2} \times p$

On squaring both sides we have,

$$a^2b^2 = (a^2 + b^2)p^2$$

$$\therefore \quad p^2 = \frac{a^2b^2}{a^2 + b^2}$$

**56.** **(a)**




Let, the radius of circle be $r$ unit.

In $\Delta OCD$, $\angle COD = 90°$

$\therefore \quad CD^2 = OC^2 + OD^2$

$\Rightarrow \quad b^2 = r^2 + r^2 = 2r^2 \qquad \cdots(1)$

In $\Delta OAB$,

$OE \perp AB$

$\angle OAB = 60°$

$AE = \dfrac{a}{2}$

$$\therefore \quad \cos 60° = \frac{AE}{OA}$$

$$\Rightarrow \quad \frac{1}{2} = \frac{\frac{a}{2}}{r}$$

$$\Rightarrow \quad \frac{1}{2} = \frac{a}{2r} \quad \Rightarrow \quad a = r \qquad \cdots(2)$$

From equations (1) and (2), we have,

$b^2 = 2a^2 \Rightarrow \quad b = \sqrt{2}a$

**57.** **(b)** $\angle A + \angle B + \angle C = 180° \qquad \cdots(1)$

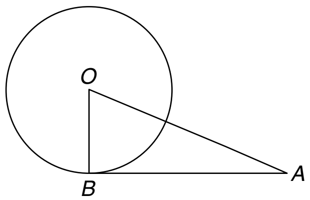
$\angle A + \dfrac{\angle B}{2} + \angle C = 140° \qquad \cdots(2)$

By equation (1) – (2), we have,

$$\frac{\angle B}{2} = 180° - 140° = \frac{\angle B}{2} = 40°$$

$\Rightarrow \quad \angle B = 80°$

**58. (d)**



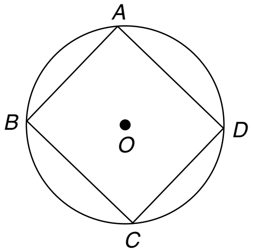

$OB = 6$ cm, $OA = 10$ cm

$\Rightarrow \quad OBA = 90°$

$\therefore \quad AB = \sqrt{OA^2 - OB^2} = \sqrt{10^2 - 6^2}$

$= \sqrt{100 - 36} = \sqrt{64} = 8$ cm

**59. (b)**




The sum of opposite angles of a concyclic quadrilateral is 180°.

$\therefore \quad \angle A + C = 180°$

$\Rightarrow \quad 4x + 5y = 180° \qquad \cdots(1)$

$\therefore \quad \angle B + \angle D = 180°$

$\Rightarrow \quad 7x + y = 180° \qquad \cdots(2)$

By equation (2) × 5 − (1), we have,

$$\begin{array}{l} 35x + 5y = 900° \\ \;\;4x + 5y = 180° \\ -\quad\; - \quad\; - \\ \hline 31x \qquad = 720 \end{array}$$

$x = \dfrac{720}{31}$

From equation (2),

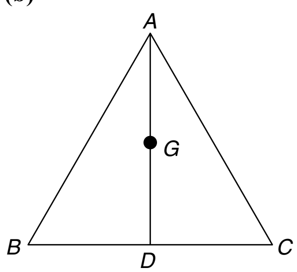
$7x + y = 180°$

$\Rightarrow \quad 7 \times \dfrac{720}{31} + y = 180°$

$\Rightarrow \quad y = 180 - \dfrac{5040}{31} = \dfrac{5580 - 5040}{31} = \dfrac{540}{31}$

$\therefore \quad x : y = \dfrac{720}{31} : \dfrac{540}{31} = 4:3$

**60. (b)**



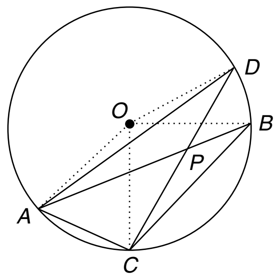

$AB = 10$ cm, $BD = 5$ cm and $\angle ADB = 90°$

$\therefore \quad AD = \sqrt{AB^2 - BD^2} = \sqrt{10^2 - 5^2} = \sqrt{100 - 25}$

$= \sqrt{75} = 5\sqrt{3}$ cm

$AG = \dfrac{2}{3} AD = \dfrac{2}{3} \times 5\sqrt{3} = \dfrac{10}{\sqrt{3}}$ cm

**61. (d)**




We have $\angle AOD = 100°$

$\therefore \quad \angle ACD = \angle ACP = \dfrac{100}{2} = 50°$

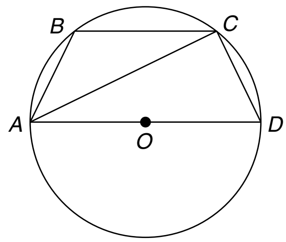
(The angle subtended at the centre is twice to that of angle at the circumference by the same arc)

Again, $\angle BOC = 70°$

$\therefore \quad \angle BAC = \dfrac{70}{2} = 35° = \angle PAC$

$\therefore \quad \angle APC = 180° - 50° - 35° = 95°$

**62. (c)**




In $\Delta ACD$

$\angle DAC = 55°$

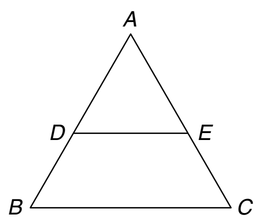
$\angle ACD = 90°$

$\angle D = 180° - 50° - 90° = 35°$

$\therefore \quad \angle ABC + \angle ADC = 180°$

$\Rightarrow \quad \angle ABC = 180° - 35° = 145°$

**63. (c)**



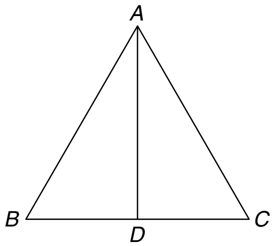
$\frac{AB}{AD} = \frac{2}{1}$

$\Delta ADE \sim \Delta ABC$

$\frac{AB}{AD} = \frac{BC}{DE} = \frac{2}{1}$

$\therefore \quad \frac{DE}{BC} = \frac{1}{2}$

**64. (b)**




$BD = DC$

$AB = AC$

$\therefore \quad \angle ADB = \angle ADC = 90°$

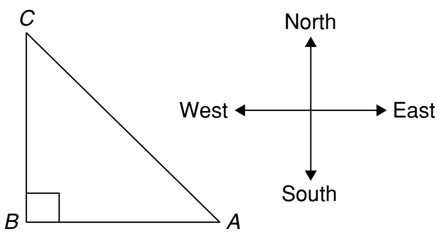
$\angle ABC = 35°$

In $\Delta ABD$

$\angle BAD + \angle ABD = 90°$

$\therefore \quad \angle BAD = 90° - 35° = 55°$

**65. (b)**




$\angle ABC = 90°$

$AB = 24$ metres, $BC = 10$ metres

$\therefore \quad AC = \sqrt{AB^2 + BC^2} = \sqrt{24^2 + 10^2}$

$\sqrt{576 + 100} = \sqrt{676} = 26$ metres

**66. (c)** $\angle A + \angle B + \angle C = 180°$ ...(1)

$(\angle B - \angle C) - (\angle A - \angle B) = 30° - 15°$

$\Rightarrow \quad 2\angle B - \angle A - \angle C = 15°$ ...(2)

By adding (1) and (2), we get,

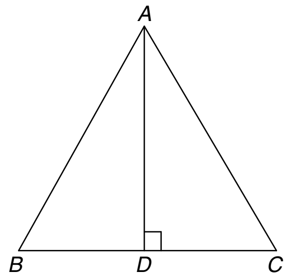
$3\angle B = 180° + 15° = 195°$

$\Rightarrow \quad \angle B = 65°, \quad \because \quad \angle A - \angle B = 15°$

$\Rightarrow \quad \angle A = 15° + 65° = 80°$

$\angle C = \angle B - 30° = 65° - 30° = 35°$

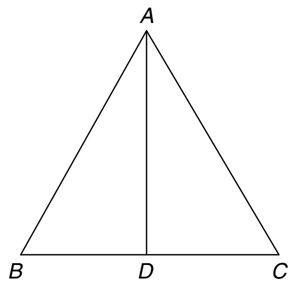
**67. (c)**




Let, $AB$ be $2x$ units.

$\Rightarrow \quad BD = DC = x$ units $\Leftrightarrow AB : BD = 2:1$

**68. (b)**




Let, $AB = AC = 2a$ units.

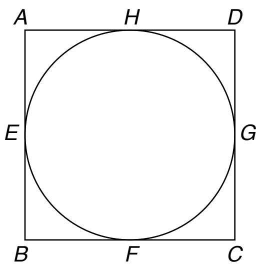
$\Rightarrow \quad BC = a$ units

$\Rightarrow \quad BD = DC = \frac{a}{2}$ units

$\Rightarrow \quad AD = \sqrt{AB^2 - BD^2} = \sqrt{4a^2 - \frac{a^2}{4}} = \sqrt{\frac{15a^2}{4}}$

$= \sqrt{\frac{15}{2}}a$ units

**69. (d)**




$AE = AH$, $BE = BF$, $GC = FC$, $GD = HD$

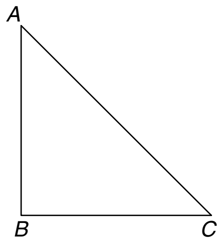
$\Rightarrow \quad AE + BE + GC + GD = AH + BF + FC + HD$

$\Rightarrow \quad AB + CD = AD + BC$

$\Rightarrow \quad 6 + 3 = AD + 7.5$

$\Rightarrow \quad AD = 9 - 7.5 = 1.5$ cm

**70. (c)**




$$AB \times BC = \frac{AC^2}{2}$$

$\Rightarrow \quad AC^2 = 2AB \times BC$

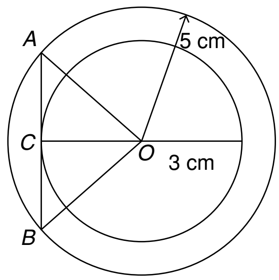
$\Rightarrow \quad AB^2 + BC^2 = 2AB \times BC$

$\Rightarrow \quad (AB - BC)^2 = 0$

$\Rightarrow \quad AB = BC$

$\therefore \quad \angle BAC = \angle ACB = 45°$

**71. (d)**

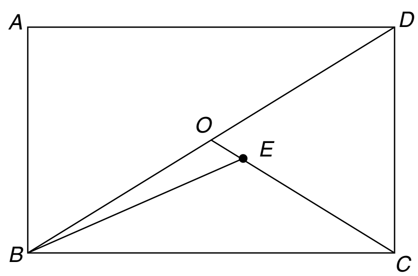



$OC = 3$ cm, $\quad OA = 5$ cm

$\therefore \quad AC = \sqrt{5^2 - 3^2} = 4$

$\therefore \quad AB = 2AC = 8$ cm

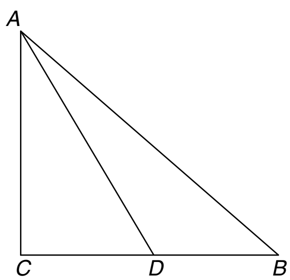
**72. (b)**




$\angle OBC = 45°, \angle OCB = 60°$

$\therefore \quad \angle BOC = 180° - 60° - 45° = 75°$

**73. (a)**




$AC^2 + BC^2 = AB^2$

$AD^2 = AC^2 + CD^2$

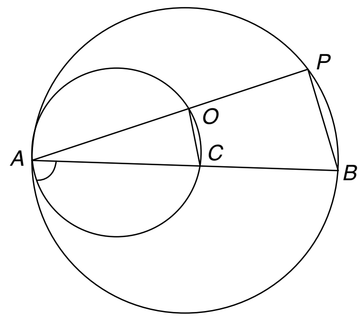
$\Rightarrow \quad AD^2 - CD^2 = AC^2$

$\therefore \quad AB^2 + AC^2 = AC^2 + BC^2 + AD^2 - CD^2$

$\Rightarrow \quad AB^2 = BC^2 + AD^2 - CD^2$

$\Rightarrow \quad AB^2 + CD^2 = BC^2 + AD^2$

**74. (d)**



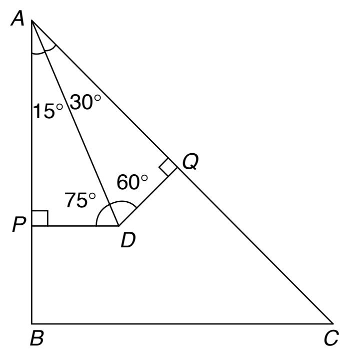

$\angle PAB = \angle QAC$

$\angle APB = \angle AQC = 90°$

$\angle QCA = \angle PBA$; $AC = BC$

$$QC = \frac{1}{2} PB$$

**75. (c)**




From $\Delta AQD$, $\sin 60° = \dfrac{AQ}{AD}$

$$\Rightarrow \quad \frac{\sqrt{3}}{2} = \frac{b}{AD} \quad \Leftrightarrow \quad AD = \frac{2b}{\sqrt{3}}$$

From $\Delta APD$,

$$\sin 75° = \frac{AP}{AD} = \frac{a}{\frac{2b}{\sqrt{3}}} = \frac{\sqrt{3}a}{2b}$$

**76. (b)** Each angle of a regular octagon

$$= \frac{1}{8}(2n - 4) \text{ right angles}$$

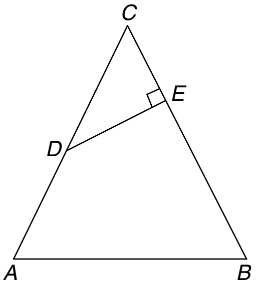
$$= \frac{1}{8}(2 \times 8 - 4) \times 90°$$

$$= \frac{12 \times 90°}{8} = 135°$$

$\because \quad 180° = \pi$ radian

$\therefore \quad 135° = \dfrac{\pi}{180} \times 135° = \dfrac{3\pi}{4}$ radian

**77. (c)**




$\angle DEC = 90°$, $DE = 18$ cm, $CE = 5$ cm

$\tan C = \dfrac{DE}{CE} = \dfrac{18}{5} = 3.6$

$\tan \angle ABC = 3.6$

$\therefore \quad \angle C = \angle B \quad \therefore \quad AC = AB$

$\angle C + \angle D = 90°$

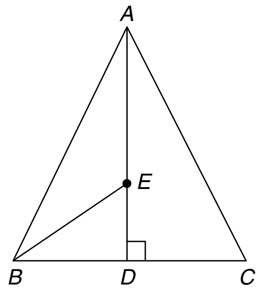
$\Rightarrow \quad 2\angle C + 2\angle D = 180°$

$\angle C + \angle A + \angle B = 180°$

$\Rightarrow \quad 2C + \angle A = 180°$

$\therefore \quad \angle A = 2\angle D \quad \therefore \quad \dfrac{AC}{CB} = \dfrac{2CD}{CE}$

**78. (c)**




$\angle BDA = 30°$, $\angle ABD = 60°$

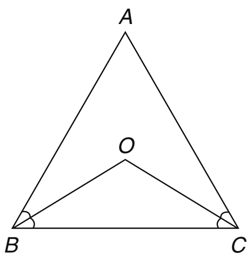
$$\frac{\tan ACB}{\tan DBE} = \frac{\frac{AD}{DC}}{\frac{DE}{BD}} = \frac{AD}{DC} \times \frac{BD}{DE} = 6\frac{BD}{DC}$$

$\therefore \quad 6\dfrac{BD}{DC} = 6 \quad \Rightarrow \quad BD = DC$

$\therefore \quad \angle ACB = 60°$

$\therefore \quad \Delta ABC$ is an equilateral triangle.

**79. (d)**



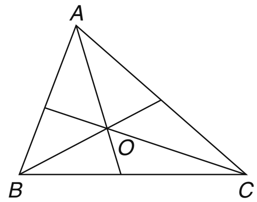

$\angle BAC = 80°$

$\therefore \quad \angle ABC + \angle ACB = 100°$

$\therefore \quad \angle OBC + \angle OCB = 50°$

$\therefore \quad \angle BOC = 180° - 50° = 130°$

**80. (d)**



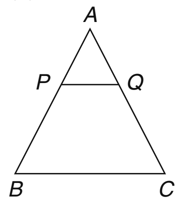

The point of intersection of internal bisectors of a triangle is called in-centre.

$\angle BOC = 90° + \dfrac{\angle A}{2}$

$\Rightarrow \quad 116° = 90° + \dfrac{\angle A}{2} \quad \Leftrightarrow \quad \dfrac{\angle A}{2} = 116 - 90° = 26°$

$\therefore \quad \angle A = 26° \times 2 = 52°$

**81. (d)**




$\Delta APQ - \Delta ABC$

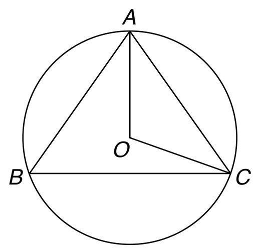
$\therefore \quad \dfrac{AP}{PB} = \dfrac{AQ}{AC} = \dfrac{PQ}{BC}$

Now, $\quad \dfrac{AB}{PB} = \dfrac{3}{1} \quad \Rightarrow \quad \dfrac{AB}{AB - AP} = \dfrac{3}{1}$

$\Rightarrow \quad \dfrac{AB - AP}{AB} = \dfrac{1}{3} \quad \Rightarrow \quad 1 - \dfrac{AP}{AB} = \dfrac{1}{3}$

$\Rightarrow \quad \dfrac{AP}{AB} = 1 - \dfrac{1}{3} = \dfrac{2}{3} = \dfrac{PQ}{BC}$

**82. (a)**




$\angle ABC = 180° - 85° - 75° = 20°$

$\angle AOC = 40°$

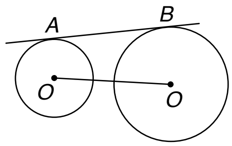
$OA = OC$

$\therefore \quad \angle OAC = \angle OCA$

$\therefore \quad \angle OAC + \angle OCA = 180° - 40° = 140°$

$\therefore \quad \angle OAC = 70°$

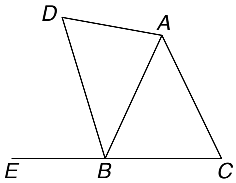
**83. (c)**




Required distance $= \sqrt{(r_1+r_2)^2-(r_1-r_2)^2}$

$= \sqrt{4r_1r_2} = \sqrt{4\times9\times4} = 2\times3\times2 = 12\text{cm}$

**84. (a)**




$BD$ is external bisector of $\angle ABC$.

$\angle ABC = 50°$

$AD \parallel BC$

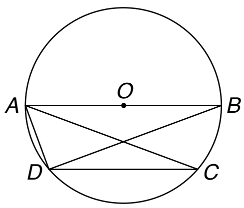
$\therefore \quad \angle DAB = 50°$

$\angle ABE = 180° - 50° = 130°$

$\therefore \quad \angle DBA = \dfrac{130°}{2} = 65°$

$\therefore \quad \angle ADB = 180° - 65° - 50° = 65°$

**85. (b)**



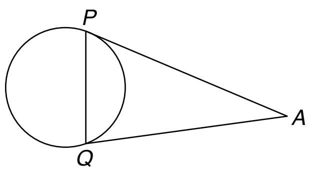

$\therefore \quad \angle BAC = \angle BDC = 20°$

(On the same are $BC$)

$\angle ADB = 90°$ (Angle of semi-circle)

$\therefore \quad \angle ADC = 90° + 20° = 110°$

**86. (a)**




$AP = AQ$

$\therefore \quad \angle APQ = \angle AQP$

$\therefore \quad \angle APQ + \angle AQP = 180° - 68° = 112°$

$\therefore \quad \angle APQ = \dfrac{112}{2} = 56°$

**87. (b)** From the formula:

$\text{Inradius} = \dfrac{\text{side}}{2\sqrt{3}}$

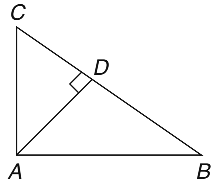
$\Rightarrow \quad 3 = \dfrac{\text{side}}{2\sqrt{3}} \quad \Rightarrow \quad \text{side} = 3\times2\sqrt{3}\text{ cm} = 6\sqrt{3}\text{ cm}.$

**88. (b)** In $\Delta ACD$ and $\Delta ABC$,

$\angle CDA = \angle CAB = 90°$

$\angle C$ is common.

$\therefore \ \Delta ACD \sim \Delta ABC$

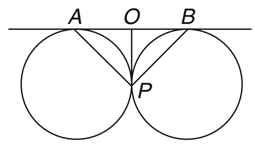



$\therefore \quad \dfrac{\Delta ACD}{\Delta ABC} = \dfrac{AC^2}{BC^2}$

$\Rightarrow \quad \dfrac{10}{40} = \dfrac{9^2}{BC^2} \qquad \Rightarrow \quad BC^2 = 4\times9^2$

$\therefore \quad BC = (2\times9) = 18\text{ cm}$

**89. (b)**



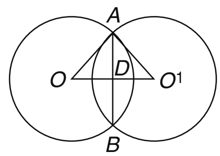

$OA = OP$

$\therefore \quad \angle PAB = OPA = 35°$

$\therefore \quad \angle AOP = 110° \Rightarrow \angle POB = 70°$

$\therefore \quad \angle ABP = \dfrac{180° - 70°}{2} = \dfrac{110}{2} = 55°$

**90. (b)**

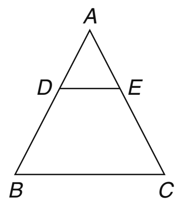



$OD = \sqrt{15^2-12^2} = \sqrt{225-144} = \sqrt{81} = 9\text{ cm}$

$O'D = \sqrt{13^2-12^2} = \sqrt{169-144} = \sqrt{25} = 5\text{ cm}$

$\therefore \quad OO' = (9+5) = 14\text{ cm}$

**91. (b)**




$DE \parallel BC$

$\angle ADE = \angle ABC$

$\angle AED = \angle ACB$

$\therefore \ \Delta ADE \sim \Delta ABC$

From the question,

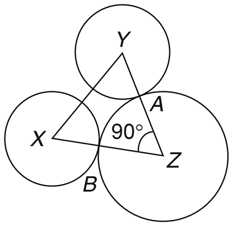
$\dfrac{\Delta BDEC}{\Delta ADE} = \dfrac{1}{1} \qquad \Rightarrow \quad \dfrac{\Delta BDEC}{\Delta ADE} + 1 = 1 + 1$

$$\Rightarrow \quad \frac{\Delta ABC}{\Delta ADE} = 2 = \frac{AB^2}{AD^2}$$

$$\Rightarrow \quad \frac{AB}{AD} = \sqrt{2} \qquad \Rightarrow \quad \frac{AB}{AD} - 1 = \sqrt{2} - 1$$

$$\Rightarrow \quad \frac{BD}{AD} = \sqrt{2} - 1 \qquad \Rightarrow \quad \frac{AD}{BD} = \frac{1}{\sqrt{2} - 1}$$

**92.** **(b)** $XZ = r + 9$




$YZ = r + 2$

$\therefore \; XY^2 = XZ^2 + ZY^2$

$\Rightarrow \quad 17^2 = (r+9)^2 + (r+2)^2$

$\Rightarrow \quad 289 = r^2 + 18r + 81 + r^2 + 4r + 4$

$\Rightarrow \quad 2r^2 + 22r + 85 - 289 = 0$

$\Rightarrow \quad 2r^2 + 22r - 204 = 0$

$\Rightarrow \quad r^2 + 11r - 102 = 0$

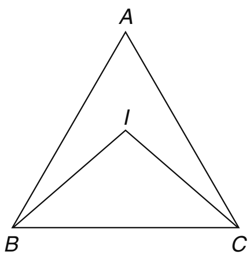
$\Rightarrow \quad r^2 + 17r - 6r - 102 = 0$

$\Rightarrow \quad r(r+17) - 6(r+17) = 0$

$\Rightarrow \quad (r-6)(r+17) = 0$

$\Rightarrow \quad r = 6$ cm

**93.** **(b)**

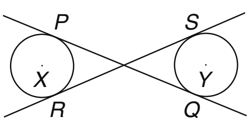



$\angle IBC = \frac{1}{2}\angle ABC = \frac{65}{2} = 32.5°$

$\angle ICB = \frac{1}{2}\angle ACB = \frac{55}{2} = 27.5°$

$\therefore \quad \angle BIC = 108° - 32.5° - 27.5° = 120°$

**94.** **(a)**




Length of transverse tangent

$= \sqrt{XY^2 - (r_1 + r_2)^2}$

$\Rightarrow \quad 8 = \sqrt{XY^2 - 9^2}$

$\Rightarrow \quad 64 = XY^2 - 81$

$\Rightarrow \quad XY^2 = 64 + 81 = 145$

$\Rightarrow \quad XY = \sqrt{145}$ cm

**95.** **(c)** Each interior angle $= \dfrac{(2n-4)\times 90°}{n}$

$$\therefore \quad \frac{\dfrac{(2n-4)\times 90°}{n}}{\dfrac{(4n-4)\times 90°}{2n}} = \frac{2}{3}$$

$$\Rightarrow \quad \frac{2n-4}{4n-4} = \frac{1}{3}$$

$\Rightarrow \quad 6n - 12 = 4n - 4$

$\Rightarrow \quad 6n - 4n = 12 - 4 = 8$

$\Rightarrow \quad 2n = 8 \;\Rightarrow\; n = 4$

**96.** **(a)** Angles of triangle $= (a-d)°, a°, (a+d)°$

$\therefore \quad a - d + a + a + d = 180°$

$\Rightarrow \quad 3a = 180° \;\Rightarrow\; a = 60°$

$$\therefore \quad \frac{a-d}{a+d} = \frac{60}{\pi} = \frac{60}{180} = \frac{1}{3}$$

$$\Rightarrow \quad \frac{60-d}{60+d} = \frac{1}{3} \qquad \Rightarrow \quad 180 - 3d = 60 + d$$

$4d = 120° \qquad \Rightarrow \quad d = 30°$

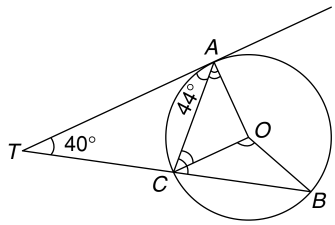
$\therefore$ Angles of triangle:

$a - d = 60° - 30° = 30°$

$a = 60°$

$a + d = 60 + 30 = 90°$

**97.** **(d)**




$\angle ACB = 40° + 44° = 84°$

$\therefore \quad \angle ACO = 90° - 44° = 46° = \angle OAC$

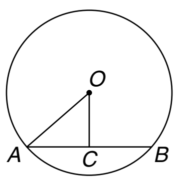
$\Rightarrow \angle OCB = \angle ACB - \angle ACO$

$= 84° - 46° = 38° = \angle OBC$

$\therefore \angle BOC = 180° - (\angle OCB + \angle OBC)$

$= 180° - (38° + 38°) = 104°$

**98.** **(c)**



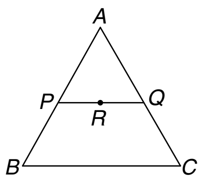
$OC = 12\text{cm}; AC = CB = 5$ cm

$\therefore$ Radius $OA = \sqrt{OC^2 + AC^2}$

$= \sqrt{12^2 + 5^2} = \sqrt{144+25} = \sqrt{169} = 13$ cm

$\therefore$ Diameter of circle $= (2 \times 13) = 26$ cm

**99.** **(c)**




$\frac{PR}{RQ} = \frac{1}{2} \Rightarrow \frac{2}{RQ} = \frac{1}{2}$

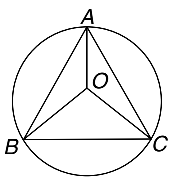
$\therefore RQ = 4$ cm

$\therefore PQ = PR + RQ = (2+4) = 6$ cm

The line joining the mid-points of two sides of a triangle is parallel to and half of the third side.

$\therefore BC = 2PQ = (2 \times 6) = 12$ cm

**100.** **(a)** The point where the right bisectors of the sides meet, is called the circum-centrre.




$OB = OC = \text{radius}$

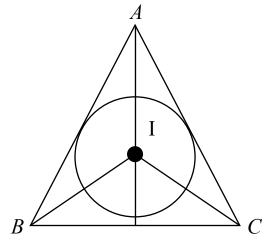
$\therefore \angle OBC = \angle OCB = 35°$

$\therefore \angle BOC = 180 - 70 = 110°$

$\therefore \angle BAC = 55°$

The angle subtended at the centre by an arc is twice to that at the circumference.

**101.** **(c)** The point where internal bisectors of angles of a triangle meet is called in-centre




$\angle BIC = 135°$

$\therefore \frac{1}{2}(\angle B + \angle C) = 45°$

$\Rightarrow \angle B + \angle C = 90°$

$\therefore \angle A = 90°$

Therefore, the triangle is the right angled triangle.

**102.** **(b)** The length of the radius of the circum-circle of an equilateral triangle $= \frac{\text{Side}}{\sqrt{3}} = \frac{6\sqrt{3}}{\sqrt{3}}$ cm. $= 6$ cm

**103.** **(a)** Sum of the adjacent angles of a parallelogram is 180°.

Smaller angle of the parallelogram $= \frac{7}{15} \times 180 = 84°$

Second largest angle of the quadrilateral $= \frac{7}{30} \times 360 = 84°$

$\therefore$ Required sum = 84 + 84 = 168°

**104.** **(c)** Sum of the adjacent angles of a parallelogram = 180°

$\therefore$ one angle of triangle $= \frac{2}{3} \times 180 = 120°$

Sum of remaining two angles = 180 – 120 = 60°

$\therefore$ second largest angle $= \frac{60}{12} \times 7 = 35°$

**105.** **(e)** $A + B + C + D = 360°$

$\Rightarrow B - 26° + B + \frac{B}{2} + \frac{B}{2} - 10° = 360°$

$\Rightarrow B = 132°; A = 132° - 26° = 106°$

**106.** **(b)** $\frac{6x}{7} = 180 \Rightarrow x = 210$

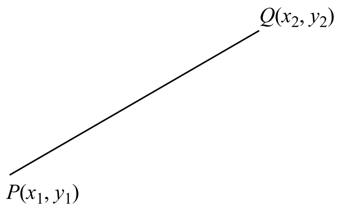
# Co-ordinate Geometry 38

## INTRODUCTION

Geometry begins with a point and straight line. Uptil now, we have studied geometry without any use of algebra. In 1637, Descartes used algebra in the study of geometrical relationships. Thus, a new type of geometry was introduced which was given the name analytical geometry or co-ordinate geometry. Thus, co-ordinate geometry is that branch of mathematics in which geometry is studied algebraically, i.e., geometrical figures are studied with the help of equations.

## SOME BASIC FORMULAE

1. **Distance Formula** Distance between two points $P(x_1, y_1)$ and $Q(x_2, y_2)$ is given by



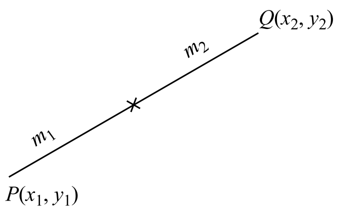

$$PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

**Illustration 1:** Find the distance between the pair of points $A(2, 5)$ and $B(-3, 7)$.

**Solution:** $AB = \sqrt{(-3-2)^2 + (7-5)^2} = \sqrt{25+4} = \sqrt{29}$.

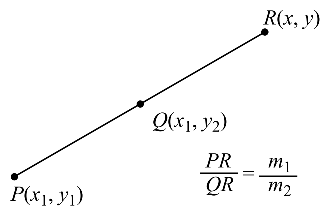
2. **Section Formulae**

(a) *Formula for internal division* The coordinates of the point $R(x, y)$ which divides the join of two given points $P(x_1, y_1)$ and Q $(x_2, y_2)$ internally in the ratio $m_1 : m_2$ are given by



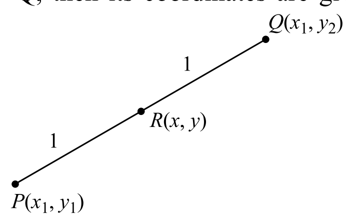

$$\left(\frac{m_1 x_2 + m_2 x_1}{m_1 + m_2}, \frac{m_1 y_2 + m_2 y_1}{m_1 + m_2}\right).$$

(b) *Formula for external division* The coordinates of the point $R(x, y)$ which divides the join of two given points $P(x_1, y_1)$ and Q $(x_2, y_2)$ externally in the ratio $m_1 : m_2$ are given by




$$\left(\frac{m_1 x_2 - m_2 x_1}{m_1 - m_2}, \frac{m_1 y_2 - m_2 y_1}{m_1 - m_2}\right).$$

(c) *Mid-point formula* If $R$ is the mid point of $P$ Q, then its coordinates are given by




$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right).$$

**Illustration 2:** Find the coordinates of the point which divides:

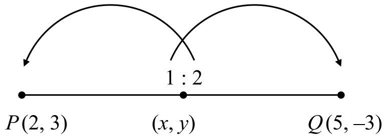
(i) the join of (2, 3) and (5, –3) internally in the ratio 1 : 2
(ii) the join of (2, 1) and (3, 5) externally in the ratio 2 : 3

**Solution:** (i) Let, $(x, y)$ be the coordinates of the point of division. Then,

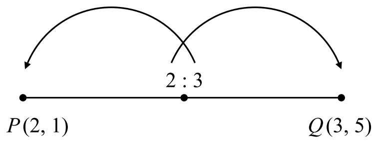
$$x = \frac{1(5) + 2(2)}{1 + 2} = \frac{5 + 4}{3} = 3$$

$$y = \frac{1(-3) + 2(3)}{1 + 2} = \frac{-3 + 6}{3} = 1.$$

$\therefore$ Coordinates of the point of division are (3, 1).




(ii) Let, $(x, y)$ be the coordinates of the point of division.




Then, $$x = \frac{2(3) - 3(2)}{2 - 3} = \frac{6 - 6}{-1} = 0$$

$$y = \frac{2(5) - 3(1)}{2 - 3} = \frac{10 - 3}{-1} = -7$$

$\therefore$ Coordinates of the point of division are (10, –7).

**Illustration 3:** Find the coordinates of the mid point of the join of points $P(2, -1)$ and $Q(-3, 4)$.

**Solution:** The coordinates of the mid-point are

$$x = \frac{2 - 3}{2} = -\frac{1}{2}$$

$$y = \frac{-1 + 4}{2} = \frac{3}{2}.$$

$\therefore$ Coordinates of the mid point are $\left(-\frac{1}{2}, \frac{3}{2}\right)$.

***Note:***

If the point R is given and we are required to find the ratio in which R divides the line segment PQ, it is convenient to take the ratio $k$:1.

Then, the coordinates of R are

$$\left(\frac{kx_2 + x_1}{k + 1}, \frac{ky_2 + y_1}{x + 1}\right).$$

**Illustration 4:** In what ratio does the point (6, – 6) divide the join of (1, 4) and (9, –12)?

**Solution:** Let, the point $R$ (6, – 6) divides the join of $P(1, 4)$ and $Q$ (9, –12) in the ration $k$:1.

By section formula, the coordinates of $R$ are

$$\left(\frac{k(9) + 1(1)}{k + 1}, \frac{k(-12) + 1(4)}{k + 1}\right), \text{ i.e., } \left(\frac{9k + 1}{k + 1}, \frac{-12k + 4}{k + 1}\right).$$

But the coordinates of $R$ are given to be (6, –6).

$$\therefore \quad \frac{9k + 1}{k + 1} = 6 \text{ and } \frac{-12k + 4}{k + 1} = -6$$

$\Rightarrow \quad 9k + 1 = 6k + 6$ and $-12k + 4 = -6k - 6$

$\Rightarrow \quad 3k = 5$ and $-6k = -10$

In either case, $k = \frac{5}{3}$ (+ve)

$\therefore$ $R$ divides $PQ$ internally in the ratio $\frac{5}{3}:1$

i.e., 5:3.

> **3. Centroid of a Triangle**
> The point of concurrence of the medians of a triangle is called the centroid of triangle. It divides the median in the ratio 2:1.
> The coordinates of the centroid of a triangle whose vertices are $(x_1, y_1)$, $(x_2, y_2)$ and $(x_3, y_3)$ are given by
> $$\left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3}\right).$$

**Illustration 5:** Find the centroid of the triangle whose angular points are (3, –5), (–7, 4) and (10, –2), respectively.

**Solution:** The coordinates of centroid are

$$\left(\frac{3 - 7 + 10}{3}, \frac{-5 + 4 - 2}{3}\right) = (2, -1).$$

> **4. Incentre of a Triangle**
> Incentre of a triangle is the point of concurrence of the internal bisectors of the angles of a triangle.
> The coordinates of the incentre of a triangle whose vertices are $(x_1, y_1)$, $(x_2, y_2)$ and $(x_3, y_3)$ are given by
> $$\left(\frac{ax_1 + bx_2 + cx_3}{a + b + c}, \frac{ay_1 + by_2 + cy_3}{a + b + c}\right).$$

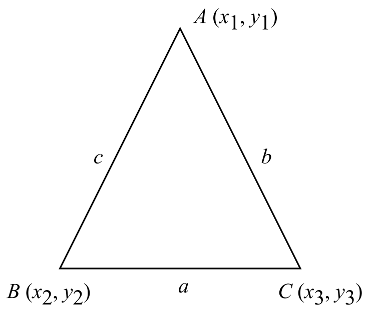



**Illustration 6:** Find the coordinates of incentre of a triangle having vertices $A(0, 0)$, $B(20, 15)$ and $C\,(-36, 15)$.

**Solution:** We have,

$$a = BC = \sqrt{(20+36)\ (15+15)^2} = 56$$

$$b = AC = \sqrt{(36)^2 + (15)^2} = 39$$

$$c = AB = \sqrt{(20) + (15)^2} = 25.$$

$\therefore$ Coordinates of incentre are

$$x = \frac{ax_1 + bx_2 + cx_3}{a+b+c} = \frac{56\cdot 0 + 39\cdot 20 + 25\cdot(-36)}{56+39+25} = -1.$$

$$y = \frac{ay_1 + by_2 + cy_3}{a+b+c} = \frac{56\cdot 0 + 39\cdot 15 + 25\cdot 15}{56+39+25} = 8.$$

Thus, $I \equiv (-1, 8)$.

5. **Area of a Triangle** The area of a triangle whose vertices are $(x_1, y_1)$, $(x_2, y_2)$ and $(x_3, y_3)$ is given by

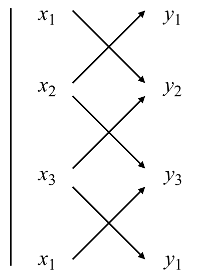
$$A = \frac{1}{2}[x_1\,(y_2 - y_3) + x_2\,(y_3 - y_1) + x_3\,(y_1 - y_2)]$$

### Condition of Collinearity of Three Points

The points $A\ (x_1,\ y_1)$, $B\ (x_2,\ y_2)$ and $C(x_3,\ y_3)$ will be collinear (i.e., will lie on a straight line) if the area of the triangle, assumed to be formed by joining them is zero.

## Shortcut Method for Finding the Area

1. Write the coordinates of the vertices taken in order in two columns. At the end, repeat the coordinates of the first vertex.




2. Mark the arrow-heads as indicated. Each arrow-head shows the product.
3. The sign of the product remains the same for downward arrows while it changes for an upward arrow.
4. Divide the result by 2.
5. Thus, $\Delta = \frac{1}{2}[(x_1\,y_2 - x_2\,y_1) + (x_2\,y_3 - x_3\,y_2) + (x_3\,y_1 - x_1\,y_3)]$.

**Illustration 7:** Find the area of a triangle whose vertices are (4, 4) (3, –2) and (–3, 16).

**Solution:** Required area

$$= \frac{1}{2}\left| -8 - 12 + 48 - 6 - 12 - 64 \right|$$

$$= \frac{1}{2}\left| -54 \right| = \frac{1}{2}(54) = 27 \text{ sq units.}$$

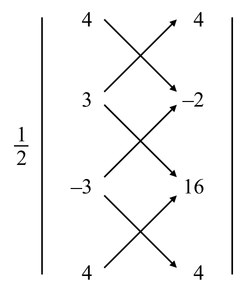
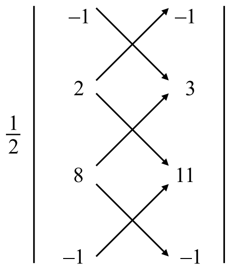



**Illustration 8:** Show that the three points (–1, –1), (2, 3) and (8, 11) lie on a line.

**Solution:** The area of the triangle whose vertices are (–1, – 1), (2, 3) and (8, 11) is

$$\Delta = \frac{1}{2}\left| -3 + 2 + 22 - 24 - 8 + 11 \right| = \frac{1}{2}\left| 0 \right| = 0$$

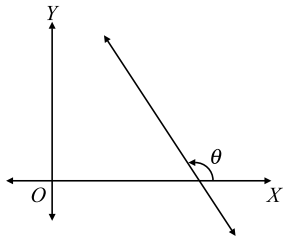
Since the area of the triangle is zero, the given points are collinear.




### Slope or Gradient of a Line

The tangent of the angle which a line makes with the positive direction of $x$-axis is called the slope or the gradient of the line. It is generally denoted by $m$. If a line makes an angle $\theta$ with $x$-axis, then its slope

$$= \tan\theta, \text{ i.e., } m = \tan\theta.$$




**Note:**

1. If a line is parallel to $x$-axis, $m = \tan 0 = 0$.
2. If a line is parallel to $y$-axis, $m = \tan 90° = \infty$.

**Illustration 9:** Find the slope of a line whose inclination with $x$-axis is 30°.

**Solution:** Slope, $m = \tan 30° = \dfrac{1}{\sqrt{3}}$.

### Slope of a Line Joining Two Given Points

The slope of the line joining two points $(x_1, y_1)$ and $(x_2, y_2)$ is

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{Difference of ordinates}}{\text{Difference of abscissae}}$$

**Illustration 10:** Find the slope of the line passing through the points (2, 3) and (4, 9).

**Solution:** Slope of the line $= \dfrac{y_2 - y_1}{x_2 - x_1}$

$$= \frac{9-3}{4-2} = 3.$$

### Parallel and Perpendicular Lines

(a) Two lines are parallel if and only if their slopes $m_1$, $m_2$ are equal, i.e., if $m_1 = m_2$.

(b) Two lines are perpendicular if and only if their slopes $m_1$, $m_2$ satisfy the condition $m_1 m_2 = -1$.

**Illustration 11:** Show that the line joining (2, –3) and (–5, 1) is:

(*a*) parallel to the line joining (7, –1) and (0, 3),
(*b*) perpendicular to the line joining (4, 5) and (0, –2).

**Solution:** Let, $l_1$ be the line joining the points (2, –3) and (–5, 1).

$\therefore$ Slope of $l_1 = \dfrac{1-(-3)}{-5-2} = -\dfrac{4}{7}$.

(*a*) Let $l_2$ be the line joining the points (7, –1) and (0, 3).

$\therefore$ Slope of $l_2 = \dfrac{3-(-1)}{0-7} = -\dfrac{4}{7}$.

$\because$ Slope of $l_1$ = slope of $l_2$ (each = –4/7).

$\therefore$ Lines $l_1$ and $l_2$ are parallel.

(*b*) Let $l_3$ be the line joining the points (4, 5) and (0, –2).

$\therefore$ Slope of $l_3 = \dfrac{-2-5}{0-4} = \dfrac{-7}{-4} = \dfrac{7}{4}$.

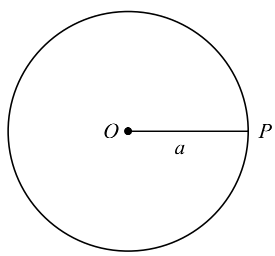
$\because$ Slope of $l_1$ × slope of $l_3 = -\dfrac{4}{7} \times \dfrac{7}{4} = -1$,

$\therefore$ the lines $l_1$ and $l_3$ are perpendicular.

### Locus

When a point moves so that it always satisfies a given condition or conditions, the path traced out by it is called its locus under these conditions.

**Illustration 12:** Let, O be a given point in the plane of the paper and let a point P move on the paper so that its distance from O is constant and is equal to a. All the positions of the moving point must lie on a circle whose centre is O and radius is a. This circle is, therefore, the locus of P when it moves under the condition that its distance from O is equal to a constant a.




## Shortcut Method to Find the Locus

1. Take a point on the locus and suppose that its coordinates are $(x, y)$.
2. Apply the given conditions(s) to $(x, y)$ and simplify the algebraic equation so formed.
3. The simplified equation is the required equation of the locus.

**Illustration 13:** A point moves so that its distance from (3, 0) is twice its distance from (–3, 0). Find the equation of its locus.

**Solution:** Let $P(x, y)$ be any point on the locus. And, $A$ (3, 0) and $B$ (–3, 0) be the given points.

By the given condition, $PA = 2\ PB$.

$$\Rightarrow \sqrt{(x-3)^2+(y-0)^2} = 2\sqrt{(x+3)^2+(y-0)^2}$$

Squaring both sides,

$x^2 + y^2 - 6x + 9 = 4\ (x^2 + y^2 + 6x + 9)$

or $\quad 3x^2 + 3y^2 + 30x + 27 = 0$

or $\quad x^2 + y^2 + 10x + 9 = 0$,

which is the required equation of the locus.

## EXERCISE-I

**1.** The distance between the points (7, 9) and (3, −7) is:

(a) $4\sqrt{15}$ (b) $4\sqrt{17}$
(c) $17\sqrt{4}$ (d) $17\sqrt{5}$

**2.** The distance between $(\cos\theta, \sin\theta)$ and $(\sin\theta, -\cos\theta)$ is:

(a) $\sqrt{3}$ (b) $\sqrt{2}$
(c) 1 (d) 0

**3.** The distance between the points (4, p) and (1, 0) is 5, then $p$ =

(a) ± 4 (b) 4
(c) −4 (d) 0

**4.** The distance between the points $(a\sin 60°, 0)$ and $(0, a\sin 30°)$ is:

(a) $a/\sqrt{2}$ (b) $a\sqrt{2}$
(c) $a/\sqrt{3}$ (d) None of these

**5.** The distance between the two points is 5. One of them is (3, 2) and the ordinate of the second is −1, then its x-coordinate is:

(a) 7, −1 (b) −7, 1
(c) −7, −1 (d) 7, 1

**6.** A line is of length 10 and one end is (2, −3). If the abscissa of the other end is 10 then its ordinate is

(a) 3 or 9 (b) −3 or −9
(c) 3 or −9 (d) −3 or 9

**7.** The nearest point from origin is:

(a) (2, −3) (b) (5, 0)
(c) (2, −1) (d) (1, 3)

**8.** The vertices of a triangle are A(2, 2), B(−4, −4), C (5, −8). Then, the length of the median through C is

(a) $\sqrt{65}$ (b) $\sqrt{117}$
(c) $\sqrt{85}$ (d) $\sqrt{113}$

**9.** P(3, 4), Q(7, 7) are collinear with the point R where PR = 10. Then, R =

(a) (5, 2) (b) (−5, 2)
(c) (−5, −2) (d) (5, −2)

**10.** The third vertex of an equilateral triangle whose two vertices are (2, 4), (2, 6) is:

(a) $(\sqrt{3}, 5)$ (b) $(2\sqrt{3}, 5)$
(c) $(2+\sqrt{3}, 5)$ (d) (2, 5)

**11.** Three points (0, 0), $(3, \sqrt{3})$, $(3, \lambda)$ form an equilateral triangle. Then, $\lambda$ =

(a) 2 (b) −3
(c) −4 (d) None of these

**12.** The perimeter of a triangle formed by (0, 0), (1, 0), (0, 1) is:

(a) $1 \pm \sqrt{2}$ (b) $\sqrt{2}+1$
(c) 3 (d) $2+\sqrt{2}$

**13.** ABC is an isosceles triangle with B ≡ (1, 3) and C ≡ (−2, 7) then A =

(a) (5/6, 6) (b) (6, 5/6)
(c) (7, 1/8) (d) None of these

**14.** The area of the triangle formed by $(a, a)$, $(a + 1, a + 1)$, $(a + 2, a)$ is:

(a) $a^3$ (b) $2a$
(c) 1 (d) $\sqrt{2}$

**15.** The ratio in which (−3, 4) divides the line joining (1, 2) and (7, −1) is:

(a) 2 : −5 (b) 5 : 2
(c) 1 : −5 (d) 1 : 5

**16.** Mid-points of the sides AB and AC of ΔABC are (3, 5) and (−3, −3) respectively, then the length of BC =

(a) 10 (b) 15
(c) 20 (d) 30

**17.** The point $(t, 2t)$, $(-2, 6)$ and $(3, 1)$ are collinear then $t =$

(a) 3/4 (b) 4/3
(c) 3 (d) 4

**18.** The base vertices of a right angled isosceles triangle are (2, 4) and (4, 2) then its third vertex is

(a) (1, 1) or (2, 2)
(b) (2, 2) or (4, 4)
(c) (1, 10) or (3, 3)
(d) (2, 2) or (3, 3)

**19.** The points $(1, -1)$, $(2, -1)$, $(4, -3)$ are the mid points of the sides of a triangle. Then its centroid is

(a) $(7, -5)$ (b) $(1/3, -1)$
(c) $(-7, 5)$ (d) $(7/3, -5/3)$

**20.** The points $(k, 2 - 2k)$, $(1 - k, 2k)$ and $(-4 - k, 6 - 2k)$ are collinear then $k =$

(a) $-1$ or $\frac{1}{2}$
(b) $-\frac{1}{2}$ or 1
(c) $-1$ or 1
(d) None of these

**21.** The point $(k, 3)$ is the centroid of the triangle formed by (2, 4), $(3, k)$ and (4, 2) then $k =$

(a) 2 (b) 3
(c) 4 (d) 5

**22.** The centroid of a triangle formed by $(7, p)$, $(q, -6)$, (9, 10) is (6, 3), then $(p, q) =$

(a) (4, 5) (b) (5, 4)
(c) $(-5, -2)$ (d) (5, 2)

**23.** The points (2, 1), (8, 5) and $(x, 7)$ lie on a straight line. Then, the value of $x$ is:

(a) 10 (b) 11
(c) $11\frac{2}{3}$ (d) 12

**24.** The points (2, 3) and (4, 1) are collinear with the point:

(a) (7, 2) (b) $(7, -2)$
(c) $(-7, 2)$ (d) $(-7, -2)$

**25.** The point (22, 23) divider the join of P(7, 5) and Q externally in the ratio 3:5, then Q =

(a) (3, 7) (b) $(-3, 7)$
(c) $(3, -7)$ (d) $(-3, -7)$

**26.** The incentre of the triangle formed by (0, 0), (5, 0) and (0, 12) is:

(a) (3, 3) (b) (2, 2)
(c) (7, 7) (d) (9, 9)

**27.** The locus of the point equidistant from $(-1, 2)$ and (3, 0) is:

(a) $2x - y - 1 = 0$
(b) $2x + y + 1 = 0$
(c) $x + y + 1 = 0$
(d) $x + y - 2 = 0$

**28.** A point moves so that its distance from y-axis is half of its distance from the origin. The locus of point is

(a) $2x^2 - y^2 = 0$
(b) $x^2 - 3y^2 = 0$
(c) $3x^2 - y^2 = 0$
(d) $x^2 - 2y^2 = 0$

**29.** The locus of the point, the sum of whose distances from the coordinate axes is 9 is:

(a) $x^2 - y^2 = 9$ (b) $x^2 - y^2 = -9$
(c) $y^2 - x^2 = 9$ (d) None of these

**30.** If A(4, 0) and B = $(-4, 0)$, then the locus of P such that PA − PB = 4 is:

(a) $3x^2 + y^2 = 12$ (b) $3x^2 - y^2 = 12$
(c) $3x^2 - y^2 = 8$ (d) None of these

**31.** The points $(k, 2k)$, $(3k, 3k)$ and (3, 1) are collinear then $k =$

(a) $\frac{1}{3}$ (b) $-\frac{1}{3}$
(c) $\frac{2}{3}$ (d) $-\frac{2}{3}$

**32.** The centroid of the triangle formed by (1, 2), $(-2, 2)$ and (1, 5) is:

(a) (1, 2) (b) (0, 3)
(c) $(-2, 2)$ (d) (5, 1)

**33.** The ratio in which (4, 5) divides the join of (2, 3), (7, 8) is:

(a) $-2{:}3$ (b) $-3{:}2$
(c) 3:2 (d) 2:3

**34.** The line segment joining $(-3, -4)$ and $(1, -2)$ is divided by $y$-axis in the ratio.

(a) 1:3 (b) 2:3
(c) 3:1 (d) 3:2

## Exercise-2
## (Based on Memory)

**1.** The curve described parametrically by

$x = t^2 + t + 1$ and $y = t^2 - t + 1$ represents

(a) A pair of straight lines
(b) An ellipse
(c) A parabola
(d) A hyperbola

**2.** Area of the triangle formed by the graph of the straight lines $x - y = 0, x + y = 2$ and the $x$-axis is:

(a) 1 square units (b) 2 square units
(c) 4 square units (d) None of these

**[SSC, 2014]**

**3.** The area (in sq. units) of the triangle formed in the first quadrant by the line $3x + 4y = 12$ is:

(a) 8 (b) 12
(c) 6 (d) 4

**[SSC Assistant Grade III, 2013]**

**4.** The area of the triangle, formed by the graph of $ax + by = c$ (where $a$, $b$ are two positive real numbers) and the coordinate axes, is:

(a) $\frac{c^2}{ab}$ square unit (b) $\frac{a^2}{2bc}$ square unit

(c) $\frac{c^2}{2ab}$ square unit (d) $\frac{a^2}{bc}$ square unit

**[SSC Assistant Grade III, 2012]**

**5.** The graph of the linear equation $3x + 4y = 24$ is a straight line intersecting $x$-axis and $y$-axis at the points A and B respectively. P(2, 0) and $Q\left(0, \frac{3}{2}\right)$ are two points on the sides OA and OB respectively of $\Delta OAB$, where O is the origin of the co-ordinate system. Given that AB = 10 cm, then PQ = ?

(a) 20 cm
(b) 2.5 cm
(c) 40 cm
(d) 5 cm

**[SSC, 2012]**

**6.** The area of the triangle formed by the straight line $3x + 2y = 6$ and the co-ordinate axes is:

(a) 3 square units
(b) 6 square units
(c) 4 square units
(d) 8 square units

**[SSC, 2012]**

**7.** The length of the intercept of the graph of the equation $9x - 12y = 108$ between the two axes is:

(a) 15 units
(b) 9 units
(c) 12 units
(d) 18 units

**[SSC, 2012]**

### ANSWER KEYS

#### Exercise-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (b) | **2.** (b) | **3.** (a) | **4.** (d) | **5.** (a) | **6.** (c) | **7.** (c) | **8.** (c) | **9.** (c) | **10.** (c) | **11.** (d) | **12.** (d) | **13.** (a) |
| **14.** (c) | **15.** (a) | **16.** (c) | **17.** (b) | **18.** (b) | **19.** (d) | **20.** (a) | **21.** (b) | **22.** (d) | **23.** (b) | **24.** (b) | **25.** (d) | **26.** (b) |
| **27.** (a) | **28.** (c) | **29.** (d) | **30.** (b) | **31.** (b) | **32.** (b) | **33.** (d) | **34.** (c) | | | | | |

#### Exercise-2

| | | | | | | |
|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (a) | **3.** (c) | **4.** (c) | **5.** (b) | **6.** (a) | **7.** (a) |

# EXPLANATORY ANSWERS

## EXERCISE-I

1. **(b)** Distance between (7, 9) and (3, –7) is

$$\sqrt{(7-3)^2+(9+7)^2}=\sqrt{16+256}=4\sqrt{17}.$$

2. **(b)** $\sqrt{(\cos\theta-\sin\theta)^2+(\sin\theta+\cos\theta)^2}$

$=\sqrt{1+1}=\sqrt{2}.$

3. **(a)** $9 + p^2 = 25 \Rightarrow p^2 = 16 \Rightarrow p = \pm 4.$

4. **(d)** Distance between ($a$ sin 60°, 0) and (O, $a$ sin 30°) is $\sqrt{(a\sin 60°)^2+(a\sin 30°)^2}$

$$=\sqrt{a^2\left(\frac{3}{4}+\frac{1}{4}\right)}=a.$$

5. **(a)** $\sqrt{(3-x)^2+(2+1)^2}=5$

$\Rightarrow (3-x)^2+9=25 \Rightarrow 9+x^2-6x+9-25=0$

$\Rightarrow x^2-6x-7=0 \Rightarrow x=7, -1.$

6. **(c)** $\sqrt{(10-2)^2+(y+3)^2}=10$

$\Rightarrow 64+y^2+9+6y-100=0$

$\Rightarrow y^2+6y-27=0 \Rightarrow y=-9, 3.$

7. **(c)** $\sqrt{(2-0)^2+(-1-0)^2}=\sqrt{5}$

$\Rightarrow$ (2, –1) is the nearest point.

8. **(c)** Mid-point of $AB=\left(\frac{2-4}{2}, \frac{2-4}{2}\right)$

$=(-1,-1)=D$

Now, $CD=\sqrt{(5+1)^2+(-8+1)^2}$

$=\sqrt{36+49}=\sqrt{85}.$

9. **(c)**

10. **(c)** Third vertex

$$=\left\{\frac{(2+2)\pm\sqrt{3}(6-4)}{2}, \frac{6+4\pm\sqrt{3}(2-2)}{2}\right\}$$

$=(2\pm\sqrt{3}, 5).$

11. **(d)** Third vertex

$$=\left\{\frac{(3+0)\pm\sqrt{3}(\sqrt{3}-0)}{2}, \frac{(\sqrt{3}+0)\mp\sqrt{3}(3-0)}{2}\right\}$$

$$=\left\{\frac{3\pm3}{2}, \frac{\sqrt{3}\mp3\sqrt{3}}{2}\right\}=(3,-\sqrt{3}) \text{ or, } (0, 2\sqrt{3}).$$

12. **(d)** Perimeter $=1+1+\sqrt{2}=2+\sqrt{2}.$

13. **(a)** $AB^2=\left(1-\frac{5}{6}\right)^2+(3-6)^2=\frac{1}{36}+9=\frac{325}{36}.$

14. **(c)** Area of $\Delta=\frac{1}{2}\begin{vmatrix} a & a & 1\\ a+1 & a+1 & 1\\ a+2 & a & 1\end{vmatrix}$

$$=\frac{1}{2}\begin{vmatrix} a & a & 1\\ 1 & 1 & 0\\ 2 & 0 & 0\end{vmatrix}\begin{matrix} R_2\to R_2-R_1\\ R_3\to R_3-R_1\end{matrix}$$

$=\frac{1}{2}|(-2)|=1.$

15. **(a)** Let, the ratio be $l{:}m$, then,

$\frac{7l+m}{l+m}=-3 \Rightarrow \frac{l}{m}=-\frac{2}{5}.$

16. **(c)** Let, $D$ = (3, 5), $E$ = (–3, –3), then

$DE=\sqrt{(3+3)^2+(5+3)^2}=\sqrt{36+64}$

$=\sqrt{100}=10 \Rightarrow BC=2\,DE=2\times10=20.$

17. **(b)** $\frac{2t-6}{t+2}=\frac{6-1}{-2-3} \Rightarrow 15t=20 \Rightarrow t=\frac{4}{3}.$

18. **(b)** $A$ = (2, 4), $B$ = (4, 2), then $C$

$$=\left\{\frac{(2+4)\pm(4-2)}{2}, \frac{(4+2)\mp(2-4)}{2}\right\}$$

$$=\left(\frac{6\pm2}{2}, \frac{6\pm2}{2}\right)=(2, 2) \text{ or, } (4, 4).$$

19. **(d)** Centroid $=\left(\frac{1+2+4}{3}, \frac{-1-1-3}{3}\right)=\left(\frac{7}{3}, \frac{-5}{3}\right).$

20. **(a)** $\begin{vmatrix} k & 2-2k & 1\\ 1-k & 2k & 1\\ -4-k & 6-2k & 1\end{vmatrix}=0$

$$\Rightarrow \begin{vmatrix} k & 2-2k & 1\\ 1-2k & 4k-2 & 0\\ -4-2k & 4 & 0\end{vmatrix}=0$$

$\Rightarrow (4-8k)-(4k-2)(-4-2k)=0$

$\Rightarrow (2k-1)(k+1)=0 \Rightarrow k=1/2, -1.$

23. **(b)** Equating the slopes, $\frac{5-1}{8-2}=\frac{7-5}{x-8}$

$\Rightarrow x-8=3 \Rightarrow x=11.$

25. **(d)** $\left(\frac{35-3x}{5-3}, \frac{25-3y}{5-3}\right)=(22, 23) \Rightarrow Q=(-3,-7).$

**27.** **(a)** $(x + 1)^2 + (y - 2)^2 = (x - 3)^2 + y^2$

$\Rightarrow \quad x^2 + 1 + 2x + y^2 + 4 - 4y = x^2 + 9 - 6x + y^2$

$\Rightarrow \quad 8x - 4y - 4 = 0 \quad \text{or,} \quad 2x - y = 1.$

**28.** **(c)** $x = \frac{1}{2}\sqrt{x^2 + y^2} \quad \Rightarrow \quad 2x = \sqrt{x^2 + y^2}$

$\Rightarrow \quad 4x^2 = x^2 + y^2$

$\Rightarrow \quad 3x^2 - y^2 = 0.$

**29.** **(d)** Sum of the distances from the axis

$= |x| + |y| = 9.$

**30.** **(b)** $PA = PB + 4 \quad \Rightarrow \quad PA^2 = (PB + 4)^2$

$\Rightarrow \quad PA^2 - PB^2 = 8PB + 16$

$\Rightarrow \quad [(x - 4)^2 + y^2] - [(x + 4)^2 + y^2] = 8PB + 16$

$\Rightarrow \quad -16x = 8PB + 16 \quad \Rightarrow \quad PB^2 = 4(x + 4)^2$

$\Rightarrow \quad [(x + 4)^2 + y^2] = 4x^2 + 8x + 4$

$\Rightarrow \quad 3x^2 - y^2 = 12.$

## Exercise-2
## (Based on Memory)

**1.** **(a)** Eliminating t from the given equations, we get $x^2 + y^2 - 2xy - 2x - 2y + 4 = 0$, which is an equation of the pair of straight lines.

**2.** **(a)** On putting $x = 0$ in

$x + y = 2,$

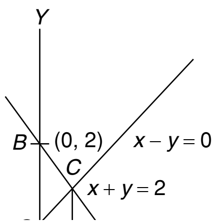
$0 + y = 2 \quad \Rightarrow \quad y = 2$

$\therefore$ Point of intersection on $y$-axis = (0, 2)

Again, putting $y = 0$ in $x + y = 2$, $x = 2$

$\therefore$ Point of intersection on $x$-axis = (2, 0)

$x - y = 0$ will pass through origin and be equally inclined to axes.




On putting $x = y$ in $x + y = 2$, we have,

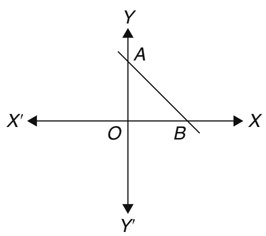
$2y = 2 \quad \Rightarrow \quad y = 1$

$\therefore \quad CD = 1$ and $OA = 2$

$$\text{Area of } \Delta OAC = \frac{1}{2} \times OA \times CD = \frac{1}{2} \times 2 \times 1$$

$$= 1 \text{ square unit}$$

**3.** **(c)**




Putting $y = 0$ in the equation $3x + 4y = 12$, we have

$3x + 0 = 12 \quad \Rightarrow \quad x = 4$

$\therefore$ Coordinates of point $B$ = (4, 0)

Again, putting $x = 0$ in the equation $3x + 4y = 12$, we have,

$0 + 4y = 12 \quad \Rightarrow \quad y = 3$

$\therefore$ Coordinates of point $A$ = (0, 3)

$\therefore \quad OB = 4$ and $OA = 3$

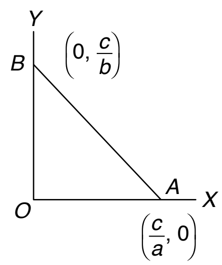
$$\therefore \text{ Area } (\Delta OAB) = \frac{I}{2} \times OB \times OA = \frac{1}{2} \times 4 \times 3$$

$$= 6 \text{ sq units}$$

**4.** **(c)** $ax + by = c$ (given)

When $x = 0$, $y = \frac{c}{b}$

When $y = 0$, $x = \frac{c}{a}$



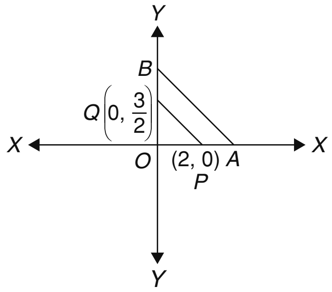

$\therefore \quad OA = \frac{c}{b}$

$OB = \frac{c}{b}$

$$\therefore \quad \text{Area of } \Delta OAB = \frac{1}{2} \times \frac{c}{a} \times \frac{c}{b} = \frac{c^2}{2ab} \text{ sq units}$$

**5.** **(b)** $OP = 2$

$OQ = \frac{3}{2}$

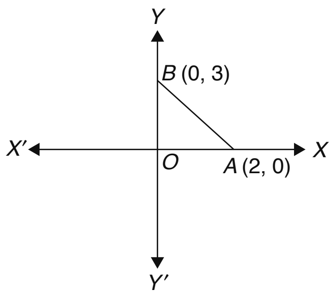



$\therefore \quad PQ = \sqrt{OP^2 + OQ^2}$

$= \sqrt{2^2 + \left(\frac{3}{2}\right)^2} = \sqrt{4 + \frac{9}{4}} = \sqrt{\frac{16+9}{4}} = \sqrt{\frac{25}{4}}$

$= \frac{5}{2} = 2.5 \text{ cm}$

**6.** **(a)** Putting $y = 0$ in the equation
$3x + 2y = 6$,
$3x + 0 = 6 \quad \Rightarrow \quad x = 2$




$\therefore$ Point of intersection on $x$-axis = (2, 0) putting $x = 0$, in the equation $3x + 2y = 6$, $0 + 2y = 6 \Rightarrow \quad y = 3$

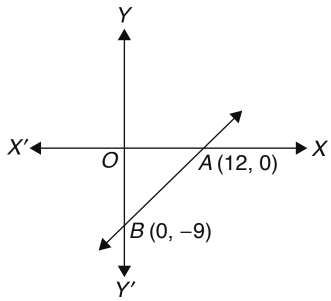
$\therefore$ Point of intersection on $y$-axis = (0, 3)

$\therefore \quad OA = 2, \ OB = 3$

$\Rightarrow \quad \Delta OAB = \frac{1}{2} \times OA \times OB$

$= \frac{1}{2} \times 2 \times 3 = 3$ sq units

**7.** **(a)**




Putting $x = 0$ in $9x - 12y = 108$,
$0 - 12y = 108 \quad \Rightarrow \quad y = -9$
Putting $y = 0$ in $9x - 12y = 108$
$9x - 0 = 108 \quad \Rightarrow \quad x = 12$
$\therefore \quad OA = 12, \ OB = 9$

$\therefore \quad AB = \sqrt{OA^2 + OB^2}$

$= \sqrt{12^2 + 9^2} = \sqrt{144 + 81} = \sqrt{225} = 15$ units

# Data Interpretation

# 39

## INTRODUCTION

Data interpretation deals with careful reading, understanding, organising and interpreting the data provided so as to derive meaningful conclusions. It is an important section today in all competitive examinations. The data representation can be broadly classified as tables, graphs and charts.

### Types of Data Representation

1. **Tables It** is the systematic and scientific presentation of *numerical data*. It helps the person to make comparisons and draw quick conclusions. Tabular presentation makes complicated information easier to understand. In a table, data is arranged systematically in columns and rows.

**Illustration 1:** In the Table below are given daily wages of male and female workers (in rupees) of two different factories:

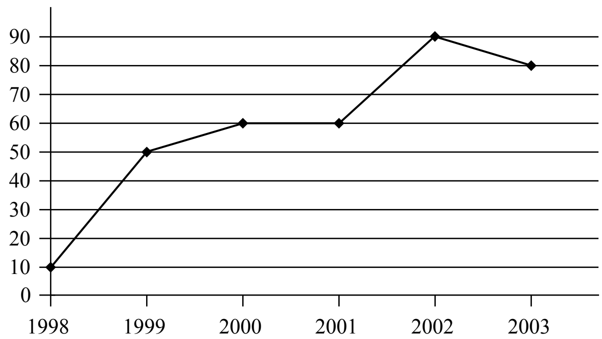
| | *FACTORY A* | | *FACTORY B* | |
|---|---|---|---|---|
| *YEAR* | *Male* | *Female* | *Male* | *Female* |
| 1997 | 120 | 120 | 240 | 200 |
| 1998 | 100 | 108 | 170 | 160 |
| 1999 | 80 | 110 | 120 | 130 |
| 2000 | 90 | 108 | 140 | 160 |
| 2001 | 170 | 130 | 240 | 260 |
| 2002 | 120 | 170 | 250 | 270 |

2. **Line Graph** A line graph depicts the variation of a quantity with respect to the two parameters calibrated on the $x$ and $y$ axes, respectively. In most of the cases the quantity is measured as a function of time, that is, the variation in the quantity as time changes.

### In the line graph:

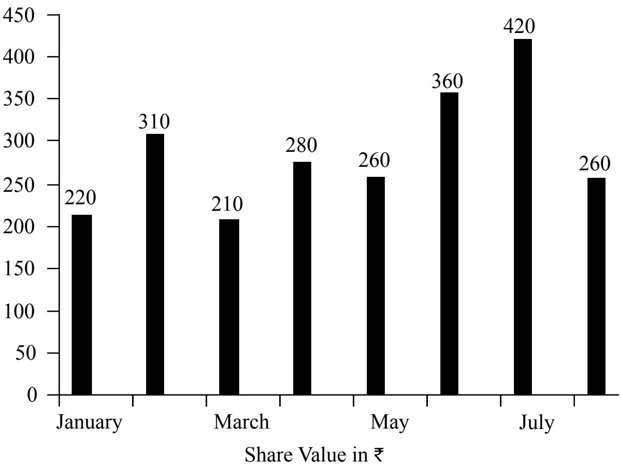
(a) $x$-axis represents the time parameter (may be year or month) and $y$-axis represents any other variable parameter which have different values with respect to time.
(b) the line going up indicates increase in the quantity with time.
(c) the line going down indicates decrease in the quantity with time.
(d) a horizontal line indicates no change in the quantity over that period.

**Illustration 2:** The following 1 ne graph shows the number of children suffering from liver disorders in a State (in thousands).




3. **Bar Graph** A bar is a thick line whose width is shown merely for attention. A bar graph consists of bars. The height of the bar is a measure of the quantity that it represents. Therefore, quantities can be compared by the height of bars in the graph. Bars may be horizontal or vertical. They may be placed adjacent to each other or may be separated from each other by spaces depending upon the problem.

**Illustration 3:** The graph given below shows the share price (in rupees) of a company during first eight months of a year.



## SHARE VALUE IN RUPEES

**Illustration 4:** The graph given below shows the yearly production and sale *of* a company in Lakh tons.

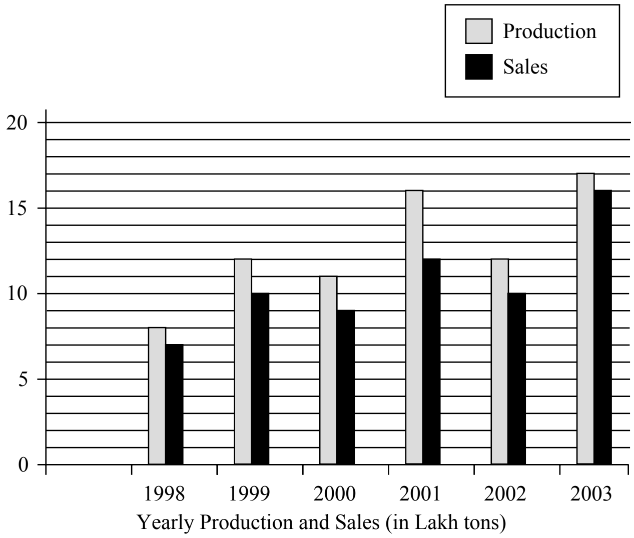
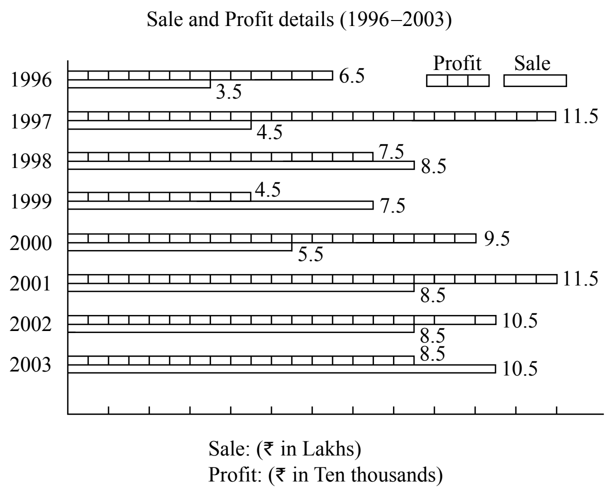



**Illustration 5:** The graph given below gives information about the sale and profit details of a departmental store during the years from 1996 to 2003.

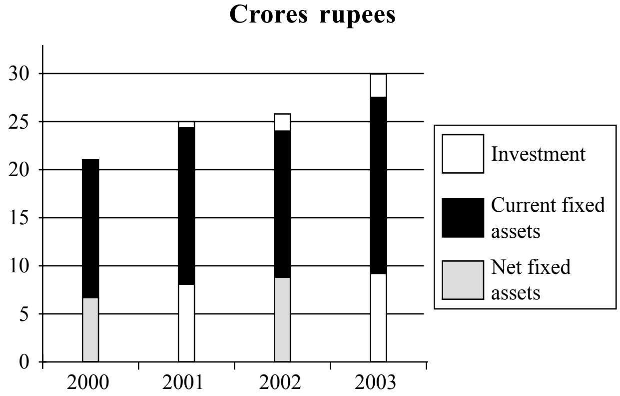
Sale and Profit details (1996–2003)




*Sale: (₹ in Lakhs,)*
*Profit: ₹ in Ten thousands*

4. **Cumulative Bar Graph** In a cumulative bar graph, the length of the bar is divided proportionately among various quantities represented in the graph. Thus, it may be conveniently used for making comparisons,

**Illustration 6:**



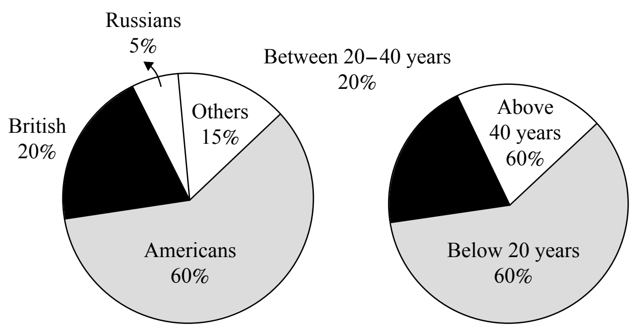

5. **Pie Charts** In a pie chart, the given data is distributed over a circle. Each part of the data makes a certain central angle.

For example, if from all the questions asked in a Bank PO exam, 25% are on data interpretation, then central angle made by this tern

$$= \left(\frac{25}{100} \times 360\right) = 90°$$

Pie charts are useful for representing percentages or proportions of variou s elements with respect to the total quantity. They also represent shares of various parts of a particular quantity.

**Illustration 7:** The following pie charts describe the characteristics of foreign tourists visiting India in a particular year.

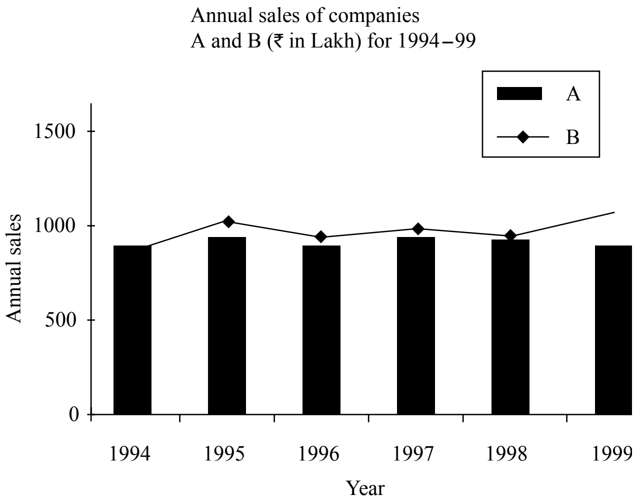



6. **Combination graph** Quite often, data interpretation question is based not on a single graph but on a combination of two or more graphs. It can be line and bar, line and pie, bar and pie, cumulative and pie charts.

**Illustration 8:** The following graph shows annual sales of companies *A* and *B* (₹ in lakh) for 1994–1999.

Annual sales of $$$mies

A and B (₹ in lakh$$$ 1994–99




**Line and Bar chart**

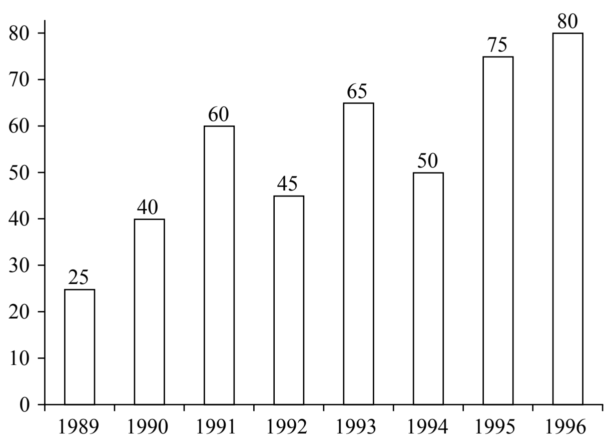
## Some Useful Instructions

1. Do not waste time memorising a Table. You can refer to it as many times as you want during the examination.
2. Your answer should be accurate and based on precise data given in the Table.
3. Do not include your own information in answering questions, however, accurate you may be. Stick to the data i resented to you.
4. Be careful about minor details. Students often miss them and give wrong answers.

## EXERCISE-I

**1.** Directions: Study the following graph carefully and answer the questions given below it.

**Production of foodgrains by a State over the years (1000 tons)**




(i) The average production of 1990 and 1991 was exactly equal to the average production of which of the following pairs of years?

(a) 1991 and 1992 (b) 1992 and 1994
(c) 1993 and 1994 (d) 1994 and 1995
(e) None of these

(ii) What was the difference in the production of foodgrains between 1991 and 1994?

(a) 10000 tons
(b) 15000 tons
(c) 500 tons
(d) 5000 tons
(e) None of these

(iii) In which of the following years was the percentage increase in production from the previous year the maximum among the given years?

(a) 1991
(b) 1993
(c) 1995
(d) 1990
(e) None of these

(iv) In how many of the given years was the production of foodgrains more than average production of the given years?

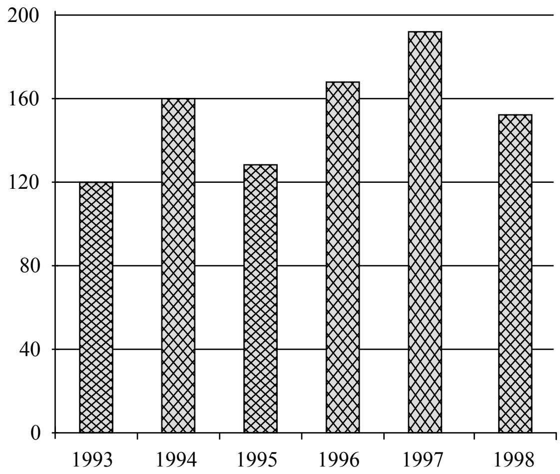
(a) 2 (b) 3
(c) 4 (d) 1
(e) None of these

(v) What was the percentage drop in the production of foodgrains from 1991 to 1992?

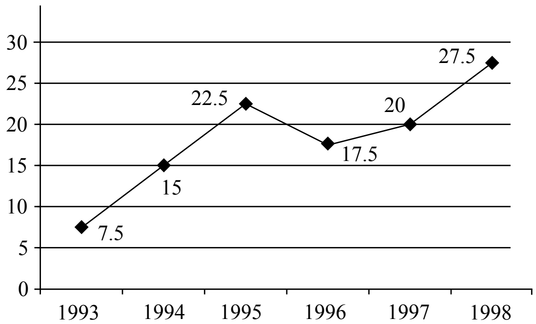
(a) 15 (b) 20
(c) 25 (d) 30
(e) None of these

**2.** Directions: Study the following graphs carefully and answer the questions given below:

### INCOME OF A COMPANY (IN ₹ LAKHS)




### PERCENTAGE PROFIT OVER THE YEARS




(i) In which of the following years was the amount of profit the maximum?

(a) 1997 (b) 1994
(c) 1993 (d) 1995
(e) None of these

(ii) **Approximately** what was the average expenditure of the given years?

(a) ₹110 Lakh (b) ₹130 Lakh
(c) ₹120 Lakh (d) ₹140 Lakh
(e) Data inadequate

(iii) In which of the following years was the increase/decrease in per cent profit from the previous year the minimum?

(a) 1994 (b) 1996
(c) 1997 (d) 1995
(e) None of these

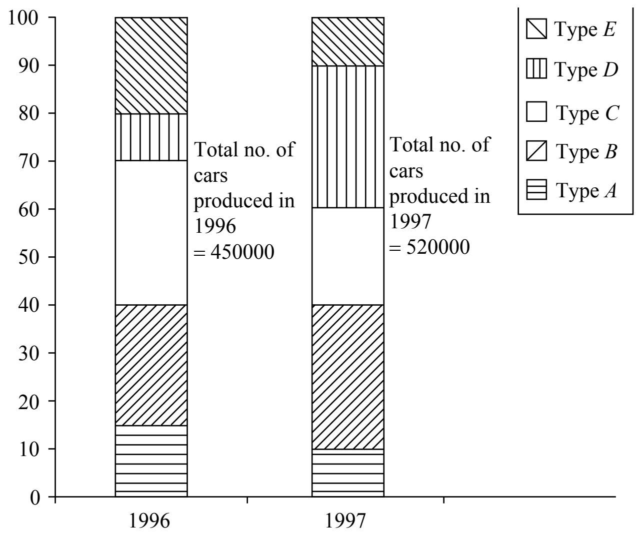
(iv) **Approximately** what was the expenditure in 1994?

(a) ₹120 Lakh (b) ₹160 Lakh
(c) ₹140 Lakh (d) ₹180 Lkh
(e) Data inadequate

(v) If the profit percentage in 1997 was 25, what would have been the expenditure in that year?

(a) ₹130 Lakh (b) ₹148 Lakh
(c) ₹120 Lakh (d) ₹152 Lakh
(e) None of these

**3.** Directions: Study the following graph carefully and then answer the questions based on it. The percentage of five different types of cars produced by a company during two years is given below.




(i) What was the difference in the production of *C* type cars between 1996 and 1997?

(a) 5000 (b) 7500
(c) 10000 (d) 2500
(e) None of these

(ii) If 85% of *E* type cars produced during 1996 and 1997 are being sold by the company, then how many *E* type cars are left unsold by the company?

(a) 142800 (b) 21825
(c) 29100 (d) 25200
(e) None of these

(iii) If the number of *A* type cars manufactured in 1997 was the same as that of 1996, what would have been its **approximate** percentage share in the total production of 1997?

(a) 11 (b) 13
(c) 15 (d) 9
(e) None of these

(iv) In the case of which of the following types of cars was the percentage increase from 1996 to 1997 the maximum?

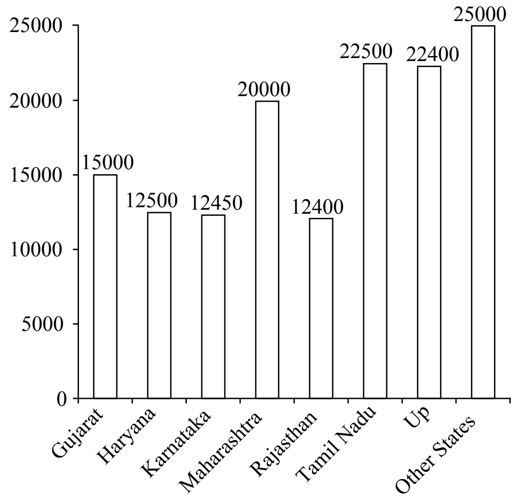
(a) A (b) E
(c) D (d) B
(e) C

(v) If the percentage production of *B* type cars in 1997 was the same as that of 1996, what would have been the number of cars produced in 1997?

(a) 112500 (b) 120000
(c) 130000 (d) Data inadequate
(e) None of these

**4.** Directions: Study the following graph carefully and answer the questions given below it.

**Rose production**




(i) Which of the following State(s) contribute(s) less than 10 per cent in the total rose production?

(a) Only Raj as than
(b) Rajasthan, Karnataka
(c) Rajasthan, Karnataka, Haryana
(d) Rajasthan, Karnataka, Haryana and Gujarat
(e) None of these

(ii) By what percentage rose production of other States is more than that of the Maharashtra?

(a) 25 (b) 30
(c) 20 (d) 15
(e) None of these

(iii) What is the **approximate** average production of roses (in thousands) across all the states?

(a) 21 (b) 20
(c) 19 (d) 18
(e) 17

(iv) Approximately what percentage of the total rose production is shared by the other States?

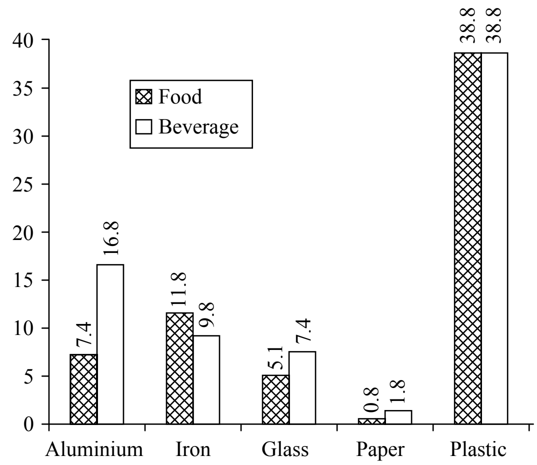
(a) 10 (b) 20
(c) 30 (d) 40
(e) 35

(v) If total percentage contribution of the States having production of roses below twenty thousand is considered, which of the following statements is true?

(a) It is little above 40%
(b) It is exactly 35%
(c) It is below 35%
(d) It is little below 30%
(e) None of these

**5**. Directions: Study the following graph carefully and answer the questions given below it.

**Packaging Materials Used (In tonnes)**




(i) What per cent of the total glass packaging material was used for packaging food items?

(a) 40.8 (b) 41.8
(c) 40.7 (d) 41.0
(e) None of these

(ii) **Approximately** how much per cent more plastic was used than iron for packaging food items?

(a) 32 (b) 320
(c) 33 (d) 325
(e) 225

(iii) In the case of which one of the following packaging materials used for packing food items and beverages respectively the ratio is 4:9?

(a) Glass (b) Paper
(c) Aluminium (d) Iron
(e) None of these

(iv) What is the ratio between the glass and aluminium packaging used for packing beverages?

(a) 17:56 (b) 56:17
(c) 84:37 (d) 37:84
(e) None of these

(v) **Approximately** what per cent of all the packaging materials used for packing food items was contributed by plastic?

(a) 60 (b) 65
(c) 70 (d) 55
(e) 50

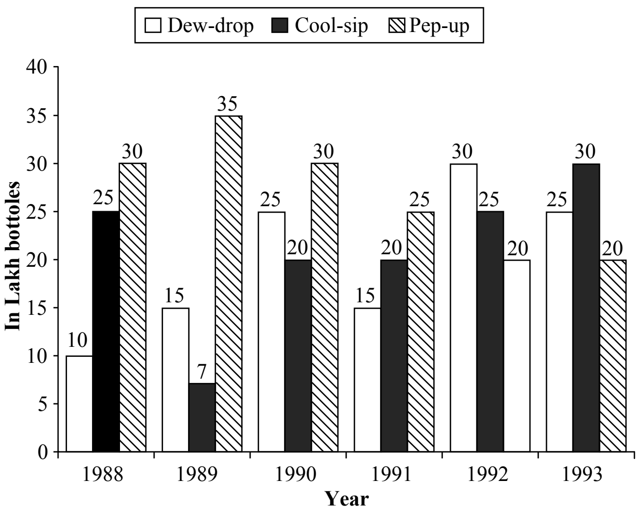
(vi) **Approximately** what per cent of all the packaging materials used for packing food items and beverages was contributed by plastic and aluminium together?

(a) 60 (b) 70
(c) 80 (d) 65
(e) 75

(vii) What per cent of all the packaging materials used for packing beverages was contributed by paper (Find the answer up to two decimal places).

(a) 2.42 (b) 3.41
(c) 2.41 (d) 3.42
(e) None of these

**6.** Directions: Study the following graph carefully and answer the questions given below.




(i) In which year was the sale of 'Pep-up' the maximum?

(a) 1990 (b) 1991
(c) 1992 (d) 1993
(e) None of these

(ii) In the case of which soft drink was the average annual sale maximum in the given period?

(a) Pep-up only (b) Cool-sip only
(c) Dew-drop only (d) Gool-sip and Dew-drop
(e) Pep-up and Dew-drop

(iii) In the case of Cool-sip drink, what was the approximate per cent increase in sale in 1992 over its sale in 1991?

(a) Less than 20 (b) 20–25
(c) 25 (d) 31–35
(e) 36–40

(iv) In the year 1990, what was the difference between the number of 'Pep-up' and 'Cool-sip' bottles sold?

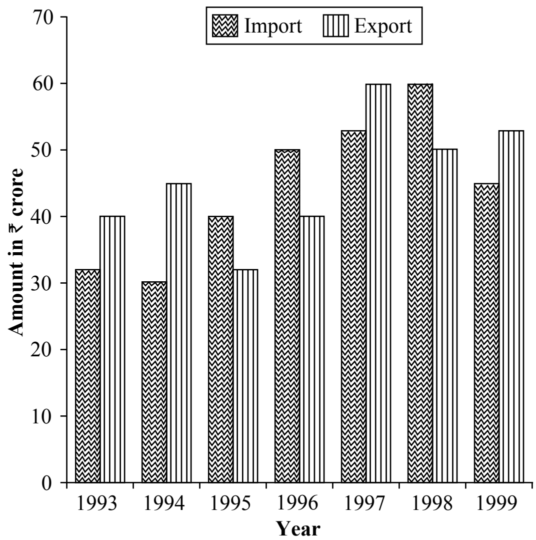
(a) 5000000 (b) 500000
(c) 50000 (d) 5000
(e) 1000000

(v) What was the approximate per cent drop in sale of Pep-up in 1990 over its sale in 1989?

(a) .5 (b) 12
(c) 14 (d) 20
(e) 28

**7.** Directions: Study the following graph carefully to answer the questions given below it.

**Import and Export of spare parts by an automobile company over the given years**




(i) During which year the percentage rise/fall in imports from the previous year is the lowest?

(a) 1994 (b) 1998
(c) 1997 (d) 1995
(e) None of these

(ii) What is the ratio of total imports to total exports for all the given years together?

(a) 31:35 (b) 35:31
(c) 65:63 (d) 63:65
(e) None of these

(iii) In which of the following pairs of years the total import is equal to total export in the same pair of years?

(a) 1996–1997 (b) 1993–1998
(c) 1998–1999 (d) 1995–1996
(e) None of these

(iv) The total exports in the years 1995, 1996 and 1999 together are what per cent of the total import during the same period? (up to two decimal places)

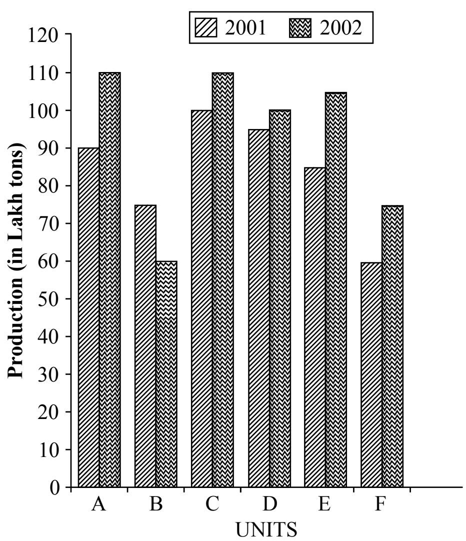
(a) 107.41 (b) 107.14
(c) 93.33 (d) 93.67
(d) None of these

(v) Which of the following pairs of years and the per cent increase in the export over the previous year is correctly matched?

(a) 1996–14.29 (b) 1997–10
(c) 1995–33.33. (d) 1994–11.11
(e) None of these

**8.** Directions: Study the following graphs carefully to answer these questions.

**Production (in Lakh tons) of six units of a company 2001 and 2002**




(i) What is the average production of all the units (in Lakh tons) for the year 2002?

(a) 89 (b) 92
(c) 87 (d) 95
(e) None of these

(ii) Average production of three units *A, B* and *C* in 2001 is what per cent of the average production of units *D, E* and *F* in 2002? (rounded off to two digits after decimal)

(a) 109.43 (b) 90.37
(c) 91.38 (d) 106.43
(e) None of these

(iii) What is the ratio of total production for two years together for unit *B* to that for *C?*

(a) 17:13 (b) 13:17
(c) 11:13 (d) 19:13
(e) None of these

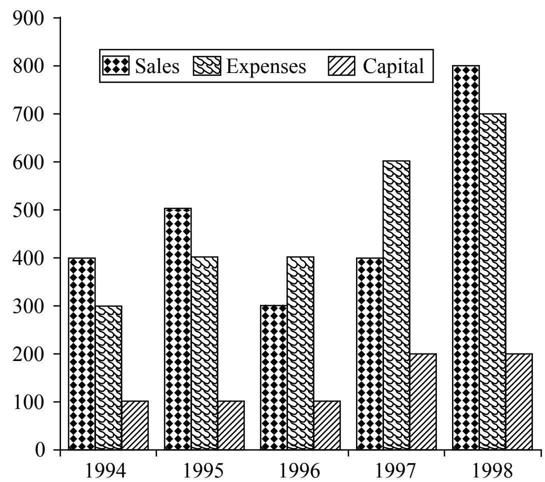
(iv) Total production for two years together by unit *F* is what per cent of the total production of the two years together by unit *D*? (rounded off to two digits after decimal)

(a) 79.49 (b) 78.49
(c) 78.47 (d) 79.29
(e) None of these

(v) What is the total production of units C, $D_9$ and *E* together for both the years? (in Lakh tons)

(a) 495 (b) 595
(c) 545 (d) 515
(e) None of these

**9.** The following graph gives Sales, Expense and Capital of a company for a period of five years–1994 to 1998. Read the graph and answer questions 140 to 144.




(i) What has been the simple average growth rate perannum of expense between 1994 and 1998?

(a) 25% (b) $33\frac{1}{3}\%$
(c) 40% (d) 130%

(ii) In which year was the sales-to-expense ratio the lowest?

(a) 199 (b) 1996
(c) 1997 (d) 1998

(iii) What was the average per annum increase in sales (in ₹ crore) from 1994 to 1998?

(a) 50 (b) 60
(c) 80 (d) 100

(iv) In which year was the ratio of profits to capital the highest?

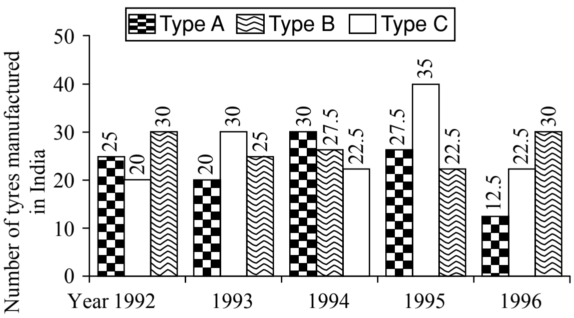
(a) 1998 (b) 1995
(c) 1996 (d) 1997

(v) In which year was the ratio of sales to capital the lowest?

(a) 1998 (b) 1997
(c) 1996 (d) 1995

**10.** Directions: Study the following graph carefully and answer the questions given below.

**Production of three types of tyres by a company over the year (in Lakh)**




(i) What was the percentage drop in the number of $C$ type tyres manufactured from 1993 to 1994?

(a) 25 (b) 10
(c) 15 (d) 25
(e) None of these

(ii) What was the difference between the number of $B$ type tyres manufactured in 1994 and 1995?

(a) 100000 (b) 2000000
(c) 1000000 (d) 1500000
(e) None of these

(iii) The total number of all the three types of tyres manufactured was the least in which of the following years?

(a) 1995 (b) 1996
(c) 1992 (d) 1994
(e) 1993

(iv) In which of the following years was the percentage production of $B$ type to $C$ type tyres the maximum?

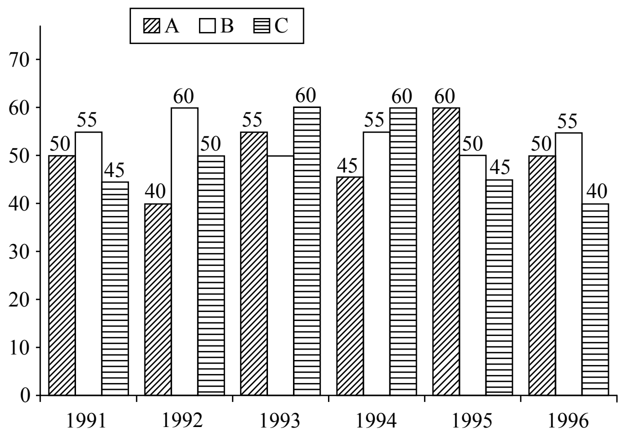
(a) 1994 (b) 1992
(c) 1996 (d) 1993
(e) 1995

(v) The total production of $C$ type tyres in 1992 and 1993 together was what percentage of production of $B$ type tyres in 1994?

(a) 50 (b) 100
(c) 150 (d) 200
(e) None of these

**11.** Directions: Study the following graph carefully to answer the questions given below it.

**Production of paper (in Lakh tonnes) by 3 different companies A, B, and C over the years**




(i) What is the difference between the production of company $C$ in 1991 and the production of company $A$ in 1996?

(a) 50000 tonnes (b) 50000000 tonnes
(c) 5000000 tonnes (d) 500000 tonnes
(e) None of these

(ii) What is the percentage increase in production of company $A$ from 1992 to 1993?

(a) 37.5 (b) 38.25
(c) 35 (d) 36
(e) None of these

(iii) For which of the following years the percentage of rise/fall in production from the previous year the maximum for company $B$?

(a) 1992 (b) 1993
(c) 1994 (d) 1995
(e) 1996

(iv) The total production of company $C$ in 1993 and 1994 is what percentage of the total production of company $A$ in 1991 and 1992?

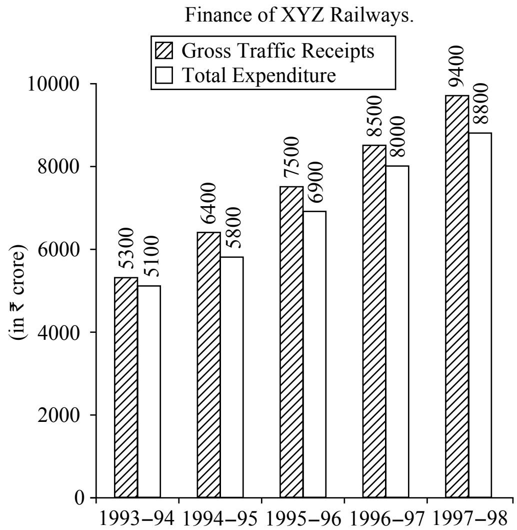
(a) 95 (b) 90
(c) 110 (d) 115
(e) None of these

(v) What is the difference between the average production per year of the company with highest average production and that of the company with lowest average production in Lakh tonnes?

(a) 3.17 (b) 4.33
(c) 4.17 (d) 3.33
(e) None of these

**12.** Directions: These questions are based on the following bar graph. Read the graph and answer the questions.

**Finances of XYZ Railways**




(i) What is the percentage increase in the gross traffic receipts in 1995–96 as compared to 1993–94?

(a) 33.9% (b) 41.5%
(c) 20.7% (d) 17%

(ii) If profit = gross traffic receipts – total expenditure, then in 1996–97, what percentage of gross traffic receipts is the profit made?

(a) 5.9% (b) 6.4%
(c) 7.2% (d) 8%

(iii) In which year was the profit as a percentage of gross traffic receipts the highest?

(a) 1997–98 (b) 1996–97
(c) 1995–96 (d) 1994–95

(iv) In order to make a profit of 10%, what should have been the gross traffic receipts (in ₹crore) in 1994–95, total expenditure remaining the same?

(a) 5667 (b) 5876
(c) 6444 (d) 7667

(v) By what amount (in ₹crore) has the expenditure increased over the period 1993–94 to 1997–98?

(a) 4100 (b) 3900
(c) 3850 (d) 3700

**13.** Directions: Study the following table carefully and answer the question given below it.

**Number of candidates from different locations appeared and passed in a competitive examination over the years**

| | *Rural* | | *Semi-urban* | | *State capitals* | | *Metropolises* | |
|---|---|---|---|---|---|---|---|---|
| *Year* | *App.* | *Passed* | *App.* | *Passed* | *App.* | *Passed* | *App.* | *Passed* |
| 1990 | 1652 | 208 | 7894 | 2513 | 5054 | 1468 | 9538 | 3214 |
| 1991 | 1839 | 317 | 8562 | 2933 | 7164 | 3248 | 10158 | 4018 |
| 1992 | 2153 | 932 | 8139 | 2468 | 8258 | 3159 | 9695 | 3038 |
| 1993 | 5032 | 1798 | 9432 | 3528 | 8529 | 3628 | 11247 | 5158 |
| 1994 | 4915 | 1668 | 9784 | 4015 | 9015 | 4311 | 12518 | 6328 |
| 1995 | 5628 | 2392 | 9969 | 4263 | 1725 | 4526 | 13624 | 6419 |

(i) For the candidates from which of the following locations was there continuous increase both in appeared and passed?

(a) Semi-urban (b) State capital
(c) State capital and Rural (d) Metropolises
(e) None of these

(ii) In which of the following years was the percentage passed to appeared candidates from semi-urban area the least?

(a) 1991 (b) 1993
(c) 1990 (d) 1992
(e) None of these

(iii) What approximate value was the percentage drop in the number of semi-urban candidates appeared from 1991 to 1992?

(a) 5 (b) 10
(c) 15 (d) 8
(e) 12

(iv) In 1993 percentage of candidates passed to **appeared** was **approximately** 35 from which location?

(a) Rural
(b) Rural and Metropolises
(c) Semi-urban and Metropolises
(d) Rural and Semi-urban
(e) None of these

(v) The total number of candidates passed **from Rural** in 1993 and Semi-urban in 1990 was **exactly equal** to the total number of candidates passed from **State** capital in which of the following years?

(a) 1990 (b) 1993
(c) 1994 (d) 1992
(e) None of these

**14.** Directions: Study the following table carefully and answer the questions given below it.

**Fare in rupees for three different types of vehicles**

| *Fare for distance up to* | *Vehicle* | | |
|---|---|---|---|
| | Type *A* | Type *B* | Type *C* |
| 2 Km | ₹5.00 | ₹7.50 | ₹10.00 |
| 4 Km | ₹900 | ₹14.50 | ₹19.00 |
| 7 Km | ₹13.50 | ₹24.25 | ₹31.00 |
| 10 Km | ₹17.25 | ₹33.25 | ₹41.50 |
| 15 Km | ₹22.25 | ₹45.75 | ₹56.50 |
| 20 Km | ₹26.00 | ₹55.75 | ₹69.00 |

***Note:***

Fare per Km for intermittent distance is the same.

(i) Shiv Kumar has to travel a distance of 15 Km in all. He decides to travel equal distance by each of the three types of vehicles. How much money is to be spent as fare?

(a) ₹51.75 (b) ₹47.50
(c) ₹47.25 (d) ₹51.25
(e) None of these

(ii) Ajit Singh wants to travel a distance of 15 Km. He starts his journey by Type *A* vehicle. After travelling 6 Km, he changes the vehicle to Type *B* for the remaining distance. How much money will he be spending in all?

(a) ₹42.25 (b) ₹36.75
(c) ₹40.25 (d) ₹42.75
(e) None of these

(iii) Mr *X* wants to travel a distance of 8 Km by Type *A* vehicle. How much more money will be required to be spent if he decides to travel by Type *B* vehicle instead of Type *A*?

(a) ₹16 (b) ₹12.50
(c) ₹14 (d) ₹13.50
(e) None of these

(iv) Rita hired a Type *B* vehicle for travelling a distance of 18 Km. After travelling 5 Km, she changed the vehicle to type A. Again, after travelling 9 Km by Type A vehicle, she changed the vehicle to Type *C* and completed her journey. How much money did she sp did in all?

(a) ₹50 (b) ₹45.50
(c) ₹55 (d) ₹50.50
(e) None of these

(v) Fare for 14th Km by Type *C* vehicle is equal to the fare for which of the following?

(a) Type *B*— 11th Km (b) Type *B*—9th Km
(c) Type *A*—4th Km (d) Type *C*— 8th Km
(e) None of these

**15.** Directions: Read the following table carefully and answer the questions given below it.

**Details of leading openers' performance in 20 one-day cricket matches**

| **Openers** | Total Runs | Highest Runs | No. of matches with runs | | |
|---|---|---|---|---|---|
| | | | 100 or more | 50–99 | 0's |
| *A* | 994 | 141 | 5 | 3 | 1 |
| *B* | 751 | 130 | 1 | 8 | 2 |
| *C* | 414 | 52 | — | 2 | 2 |
| *D* | 653 | 94 | — | 4 | 1 |
| *E* | 772 | 85 | — | 7 | — |

(i) What is the difference between the **average runs** of top two openers in terms of **highest runs,** if matches having 0's were ignored?

(a) 4.7 (b) 13.7
(c) 11.1 (d) 16.62
(e) None of these

(ii) If matches having zero runs and the one with highest runs is ignored, what will be the average runs for opener *C*?

(a) 21.29 (b) 21.79
(c) 20.7 (d) 21.17
(e) 20.19

(iii) By how much the difference between the two highest total runs differs from the difference between the two lowest total runs?

(a) Lower by 18 (b) More by 18
(c) Lower by 4 (d) More by 4
(e) None of these

(iv) Which of the given pairs of openers have ratio 3:2 in their highest runs?

(a) *B* and *D* (b) *B* and *C*
(c) *A* and *D* (d) *D* and *C*
(e) None of these

(v) Excluding the match with the highest runs and matches with 50–99 runs, what will be the **approximate** average runs for opener *B*?

(a) 25 (b) 15
(c) 10 (d) 30
(e) None of these

**16.** Directions: Read the following Table carefully and answer the questions given below.

**Highest marks and average marks obtained by students in subjects over the years.**
**The maximum marks in each subjects is 100.**

| | Subjects | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | English | | Hindi | | Maths | | Science | | History | |
| | High | Avg | High | Avg | High | Avg | High | Avg | High | Avg |
| 1992 | 85 | 62 | 75 | 52 | 98 | 65 | 88 | 72 | 72 | 46 |
| 1993 | 80 | 70 | 80 | 53 | 94 | 60 | 89 | 70 | 65 | 55 |
| 1994 | 82 | 65 | 77 | 54 | 85 | 62 | 95 | 64 | 66 | 58 |
| 1995 | 71 | 56 | 84 | 64 | 92 | 68 | 97 | 68 | 68 | 49 |
| 1996 | 75 | 52 | 82 | 66 | 91 | 64 | 92 | 75 | 70 | 58 |
| 1997 | 82 | 66 | 81 | 57 | 89 | 66 | 98 | 72 | 74 | 62 |

(i) What was the grand average marks of the five subjects in 1996?

(a) 63 (b) 64
(c) 65 (d) 68
(e) None of these

(ii) The difference in the average marks in History between 1994 and 1995 was exactly equal to the difference in the highest marks in Hindi between which of the following pairs of years?

(a) 1992 and 1995 (b) 1993 and 1995
(c) 1992 and 1996 (d) 1993 and 1997
(e) None of these

(iii) What was the **approximate** percentage increase in average marks in History from 1992 and 1993?

(a) 20 (b) 25
(c) 24 (d) 16
(e) 18

(iv) The average highest marks in English in 1992, 1993 and 1996 was exactly equal to the highest marks in Hindi in which of the following years?

(a) 1996 (b) 1997
(c) 1994 (d) 1996
(e) 1993

(v) The difference between the highest marks and the average marks in Hindi was maximum in which of the following years?

(a) 1994 (b) 1997
(c) 1995 (d) 1996
(e) 1993

(vi) The highest marks in Hindi in 1993 was what per cent of the average marks in Mathematics in 1996?

(a) 135 (a) 130
(c) 125 (d) 140
(e) None of these

(vii) If there were 50 students in 1993, what was the total marks obtained by them in Mathematics?

(a) 2400 (b) 3000
(c) 2500 (d) 3200
(e) None of hese

(viii) The difference between the highest marks in Science was maximum between which of the following pairs of years among the given years?

(a) 1992 and 993 (b) 1992 and 1996
(c) 1996 and 997 (d) 1992 and 1995
(e) None of these

**17.** Directions: Read the following information carefully and answer the questions based on it.

**In 6 educational years, number of students taking admission and leaving from the .5 different schools which are for nded in 1990 are given below.**

| School | *A* | | *B* | | *C* | | *D* | | *E* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ad | L | Ad | L | Ad | L | Ad | L | Ad | L |
| 1992 | 1025 | — | 950 | — | 1100 | — | 1500 | — | 1450 | — |
| 1993 | 230 | 120 | 350 | 150 | 320 | 130 | 340 | 150 | 150 | 125 |
| 1994 | 190 | 110 | 225 | 115 | 300 | 150 | 300 | 160 | 280 | 130 |
| 1995 | 245 | 100 | 185 | 110 | 260 | 125 | 295 | 120 | 310 | 120 |
| 1996 | 280 | 150 | 200 | 90 | 240 | 140 | 320 | 125 | 340 | 110 |
| 1997 | 250 | 130 | 240 | 120 | 310 | 180 | 360 | 140 | 325 | 115 |

In the above table shown Ad = Admitted, L = Left

(i) What is the average number of students studying in all the five schools in 1992?

(a) 1494 (b) 1294
(c) 1590 (d) 1640
(e) None of these

(ii) What was the number of students studying in school *B* in 1994?

(a) 2030 (b) 1060
(c) 1445 (d) 1150
(e) None of these

(iii) Number of students leaving school *C* from the year 1990 to 1995 is approximately what

percentage of number of students taking admission in the same school and in the same year?

(a) 50% (b) 25%
(c) 48% (d) 36%
(e) 29%

(iv) What is the difference in the number of students taking admission between the years 1991 and 1995 in school *D* and *B*?

(a) 514 (b) 1065
(c) 965 (d) 415
(e) None of these

(v) In which of the following schools, percentage increase in the number of students from the year 1990 to 1995 is maximum?

(a) *A* (b) *B*
(c) *C* (d) *D*
(e) *E*

**18.** Directions: Study the following Table and answer the following questions carefully.

**Following Table shows the percentage population of six States below poverty line and the proportion of male and female.**

| State | Percentage population below poverty line | Proportion of male and female Below poverty line M:F | Above poverty line M:F |
|---|---|---|---|
| A | 12 | 3:2 | 4:3 |
| B | 15 | 5:7 | 3:4 |
| C | 25 | 4:5 | 2:3 |
| D | 26 | 1:2 | 5:6 |
| E | 10 | 6:5 | 3:2 |
| F | 32 | 2:3 | 4:5 |

(i) The total population of state *A* is 3000, then what is the approximate no, of females above poverty line in state *A*?

(a) 1200 (b) 2112
(c) 1800 (d) 1950
(e) 2025

(ii) If the total population of C and *D* together is 18000, then what is the total no. of females below poverty line in the above stated states?

(a) 5000 (b) 5500
(c) 4800 (d) Data inadequate
(e) None of these

(iii) If the population of males below poverty line in State *A* is 3000 and that in State *E* is 6000, then .what is the ratio of the total population of State *A* and *E*?

(a) 3:4 (b) 4:5
(c) 1:2 (d) 2:3
(e) None of these

(iv) If the population of males below poverty line in State *B* is 500 then what is the total population of that State?

(a) 14400 (b) 6000
(c) 8000 (d) 7600
(e) None of these

(v) If in State *E* population of females above poverty line is 19800 then what is the population of males below poverty line in that State?

(a) 55000 (b) 30000
(c) 29700 (d) Date inadequate
(e) None of these

**19.** Direction the following Table carefully and answer the questions given below.

**Production of main crops in India (in millionon tonnes)**

| **Crops** | **91–92** | **92–93** | **93–94** | **94–95** | **95–96** | **96–97** |
|---|---|---|---|---|---|---|
| Pulses | 20.5 | 22.4 | 24.6 | 23.5 | 27.8 | 28.2 |
| Oilseeds | 32.4 | 34.6 | 40.8 | 42.4 | 46.8 | 52.4 |
| Rice | 80.5 | 86.4 | 88.2 | 92.6 | 94.2 | 90.8 |
| Sugercane | 140.8 | 150.2 | 152.2 | 160.3 | 156.4 | 172.5 |
| Wheat | 130.2 | 138.4 | 146.8 | 141.6 | 152.2 | 158.4 |
| Coarse grain | 45.6 | 52.8 | 60.4 | 62.4 | 58.2 | 62.8 |
| **Sum** | **450** | **484.8** | **513.2** | **522.8** | **535.6** | **565.1** |

(i) Production of sugarcane in 1993–94 was approximately what percentage of production of rice in 1992–93?

(a) 50 (b) 75
(c) 150 (d) 125
(e) 175

(ii) Production of what type of crop was going to increase in each year in the given years?

(a) Rice (b) Pulse
(c) Sugarcane (d) Oilseeds
(e) None of these

(iii) What was the average production of pulse in the given years?

(a) 26.8 million tones (b) 20.5 million tonnes
(c) 24.5 million tones (d) 22.5 million tonnes
(e) None of these

(iv) Production of oilseeds was what percentage of the total crops produced in the year 1991–92?

(a) 7.2 (b) 8.4
(c) 2.7 (d) 6.4
(e) None of these

(v) In which of the following years the total production *of* oil seeds in the years 1994–95, 1995–96 and 1996–97 was equal to the production of wheat?

(a) 1993–94 (b) 1994–95
(c) 1996–97 (d) 1992–93
(e) None of these

**20.** Directions: Study the following Tables carefully and answer the questions given below.

**Number of Cars (in thousands) of Different Models and Colours sold in two Metro Cities in a year**

| Type | Metro M Colour | | | | |
|---|---|---|---|---|---|
| | Black | Red | Blue | White | Silver |
| A | 40 | 25 | 55 | 75 | 15 |
| B | 20 | 35 | 60 | 80 | 20 |
| C | 35 | 30 | 50 | 90 | 35 |
| D | 45 | 40 | 45 | 85 | 40 |
| E | 50 | 35 | 35 | 60 | 30 |
| F | 55 | 42 | 40 | 65 | 52 |

| Type | Metro H Colour | | | | |
|---|---|---|---|---|---|
| | Black | Red | Blue | White | Silver |
| A | 45 | 32 | 40 | 60 | 20 |
| B | 30 | 37 | 39 | 81 | 35 |
| C | 40 | 42 | 41 | 6 | 37 |
| D | 35 | 39 | 37 | 90 | 42 |
| E | 50 | 44 | 43 | 77 | 22 |
| F | 47 | 34 | 45 | 87 | 17 |

(i) The difference between the white-coloured cars sold in the two metros of which of the following models is the **minimum**?

(a) *A* (b) *C*
(c) *D* (d) *F*
(e) None of these

(ii) The total number of blue-coloured cars of Model *E* and *D* sold in Metro *H* is exactly equal to the number of white-coloured cars of which model in Metro *M*?

(a) *B* (b) *F*
(c) *C* (d) *A*
(e) None of these

(iii) What is the difference between the number of blue-colour cars of model '*C*' sold in Metro *M* and number of red colour cars of model '*F*' sold in Metro *H*?

(a) 8,000 (b) 10,000
(c) 12,000 (d) 15,000
(e) None of these

(iv) The total number of silver-coloured cars sold in Metro *H* is approximately what percentage of that in Metro *M*?

(a) 130 (b) 140
(c) 90 (d) 100
(e) 110

(v) In Metro *M* the number of cars sold was maximum for which of the colour-model combinations?

(a) White-*C* (b) Blue-*B*
(c) Silver-*B* (d) White-*D*
(e) None of these

**21.** Directions: Study the following Table to answer the given questions.

**Number of students of different classes of a school playing different games**

| Class → Games ↓ | XII | XI | X | IX | VIII | VII | VI |
|---|---|---|---|---|---|---|---|
| Chess | 11 | 12 | 5 | 4 | 2 | 2 | 1 |
| Cricket | 38 | 40 | 12 | 17 | 25 | 18 | 20 |
| Basketball | 11 | 9 | 7 | 6 | 0 | 0 | 0 |
| Table Tennis | 9 | 9 | 21 | 19 | 11 | 9 | 0 |
| Football | 40 | 27 | 18 | 19 | 12 | 16 | 14 |
| Carrom | 16 | 15 | 8 | 19 | 12 | 16 | 14 |
| Tennis | 8 | 9 | 11 | 5 | 6 | 0 | 0 |
| Badminton | 47 | 39 | 33 | 21 | 19 | 0 | 0 |

(i) **Approximately** what per cent of Class VIII students play Cricket out of the total students playing Cricket?

(a) 13 (b) 4
(c) 25 (d) 15
(e) 17

(ii) What is the ratio of the students playing Football in Class XI to those in Class *X*?

(a) 1:2 (b) 2:5
(c) 2:3 (d) 3:2
(e) None of these

(iii) Which game is the most popular?

(a) Badminton (b) Football
(c) Carrom (d) Table Tennis
(e) Cricket

(iv) **Approximately** what per cent of Class *X* students play Table Tennis out of the total Class *X* students playing the different given games?

(a) 20 (b) 21
(c) 27 (d) 26
(e) 18

(v) Which game has ascending number of students from class IX to XII?

(a) Basketball Only (b) Badminton Only
(c) Chess and Badminton (d) No game
(e) None of these

**22.** Directions: A Table showing the percentages of the total population of a State by age groups for the year 1991 is given below. Answer the questions given below it.

| *Age Group (in years)* | *Per cent* |
|---|---|
| up to 15 | 30.00 |
| 16–25 | 17.75 |
| 26–35 | 17.25 |
| 36–45 | 14.50 |
| 46–55 | 14.25 |
| 56–65 | 5.12 |
| 66 and above | 1.13 |
| Total | 100.0 |

(i) Which age group accounts for the maximum population in the State?

(a) 16–25 (b) 26–35
(c) 36–45 (d) 56–65

(ii) Out of every 4200 persons, the number of persons below 26 years is:

(a) 2006 approx (b) 1260 approx
(c) 746 approx (d) 515 approx

(iii) There are 200 million people below 36 years. How many million (approx) people are in the age group 56–65?

(a) 30.07 (b) 15.75
(c) 12.72 (d) 59.30

(iv) If there are 10 million people in the age group 56 years and above, what is the difference between the number of people in the age groups 16–25 and 46–55?

(a) 6.8 million (b) 5.6 million
(c) 28.4 million (d) 34.7 million

(v) If the difference between the number of people in the age groups 46–55 and 26–35 is 11.75 million, then total population of State is approximately

(a) 360.23 million (b) 391.67 million
(c) 400 million (d) 460.67 million

**23.** Directions: Study the following table to answer these questions based on it

***XYZ* Co. (Pvt.) Ltd. (in Lakh of ₹)**

| *Year* | *Total Sales* | *Gross Profit* | *Net Profit* |
|---|---|---|---|
| 1990 | 351.6 | 155.5 | 54.2 |
| 1991 | 407.9 | 134.3 | 42.6 |
| 1992 | 380.1 | 149.9 | 38.9 |
| 1993 | 439.7 | 160.5 | 50.3 |
| 1994 | 485.9 | 203.3 | 65.8 |

(i) In which year the difference between the total sales and the gross profit is the least?

(a) 1990 (b) 1991
(c) 1992 (d) 1993

(ii) The total sales in 1993 is approximately what per cent of the total sales in 1990?

(a) 75 (b) 85
(c) 110 (d) 125

(iii) Which years show increase in all the categories simultaneously, that is total sales, gross profit and net profit as compared to the previous year?

(a) 1993 and 1994 both
(b) 1994 and 1992 both
(c) 1992 and 1993 both
(d) 1990 and 1991 both

(iv) The net profit in 1991 is **approximately** what per cent of the total sales in 1993?

(a) 6.5 (b) 7
(c) 8 (d) 9.7

(v) The per cent increase in the gross profit was the largest in which year as compared to the previous one?

(a) 1991 (b) 1992
(c) 1993 (d) 1994

**24.** Directions: Refer to the following Table. Read the Table and answer the questions.

**Foodgrain Production in a Country in 1999 (in Lakh tons)**

| *State* | *Rice* | *Wheat* | *Jowa* | *Pulses* | Others |
|---|---|---|---|---|---|
| *P* | 45 | 103 | — | 27 | 29 |
| *Q* | 48 | 86 | 73 | 19 | 15 |
| *R* | 59 | 32 | 67 | 14 | 31 |
| *S* | 41 | 37 | 59 | 21 | 15 |
| *T* | 37 | 22 | 41 | 13 | 11 |
| *U* | 68 | 15 | 12 | — | 18 |
| *V* | 57 | 8 | 7 | 12 | 10 |
| *W* | 38 | 28 | 31 | 22 | 45 |

(i) Which State had the highest grain production?

(a) *P* (b) *Q*
(d) *R* (d) *S*

(ii) What was the proportion of rice production to wheat production in the country?

(a) 1:1 (b) 0.8:1
(c) 1.2:1 (d) 2:1

(iii) Jowar was the most important foodgrain in the State/States;

(a) *Q, R, S* (b) *Q*
(c) *R, S* (d) *R, S, T*

(iv) States *P* alone accounted for **approximately** what percentage of wheat production in the country?

(a) 73% (b) 50%
(c) 41% (d) 30%

(v) If the average per hectare yield of rice in the country was 30 tons, then the area (approx.) under rice cultivation during the year was (in Lakh hectares)

(a) 1.5 (b) 8
(c) 13 (d) 40

**25.** Directions: Following Table gives the population of a locality from 1988 to 1992. Read the Table and answer the questions.

| *Year* | *Men* | *Women* | *Children* | *Total* | *Increase (+) or decrease (–) over preceding year* |
|---|---|---|---|---|---|
| 1988 | 65104 | 60387 | — | 146947 | — |
| 1989 | 70391 | 62516 | — | — | + (11630) |
| 1990 | — | 63143 | 20314 | 152922 | — |
| 1991 | 69395 | — | 21560 | — | – (5337) |
| 1992 | 71274 | 65935 | 23789 | 160998 | — |

(i) The number of children in 1988 is:

(a) 31236 (b) 125491
(c) 14546 (d) 21456

(ii) The number of children in 1989 is:

(a) 144537 (b) 158577
(c) 146947 (d) 149637

(iii) The number of women in 1991 is:

(a) 25670 (b) 14040
(c) 13970 (d) 15702

(iv) The number of women in 1991 is:

(a) 57630 (b) 56740
(c) 52297 (d) 62957

(v) Increase or decrease of population in 1992 over 1991 is:

(a) – (12413) (b) + (12413)
(c) + 155661 (d) + 7086

**26.** Directions: The Table given below shows production of five types of cars by a company in the years 1989 to 1994. Study the Table and answer questions.

**Production of cars by a company**

| Year → Type ↓ | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | Total |
|---|---|---|---|---|---|---|---|
| *P* | 8 | 20 | 16 | 17 | 21 | 6 | 88 |
| *Q* | 16 | 10 | 14 | 12 | 12 | 14 | 18 |
| *R* | 21 | 17 | 16 | 15 | 13 | 8 | 90 |
| *S* | 4 | 6 | 10 | 16 | 20 | 31 | 87 |
| *T* | 25 | 18 | 19 | 30 | 14 | 27 | 133 |
| Total | 74 | 71 | 75 | 90 | 80 | 86 | 476 |

(i) In which year the production of cars of all types taken together was approximately equal to the average of the total production during the period?

(a) 1989 (b) 1991
(c) 1993 (d) 1994

(ii) In which year the total production of cars of types *P* and *O* together was equal to the total production of cars of types *R* and *S* together?

(a) 1990 (b) 1991
(c) 1994 (c) None of the above

(iii) During the period 1989–94, in which type of cars was a continuous increase in production?

(a) *P* (b) *Q*
(c) *R* (d) *S*

(iv) The production of which type of cars was 25% of the total production of all types of cars during 1993?

(a) *S* (b) *R*
(c) *Q* (d) *P*

(v) The per cent increase in total production of all types of cars in .1993 to that in 1991 was?

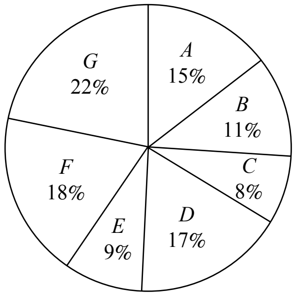
(a) 15 (c) 20
(c) 25 (d) 30

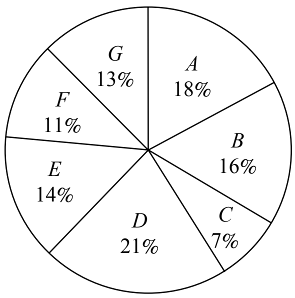
**27.** Directions: These questions are based on the following graphs:

**Classification of appeared candidates in a competitive test from different States and qualified candidates from those States.**

**Appeared candidates = 45000.**

**Qualified candidates = 9000.**




(i) What is the ratio of the number of appeared candidates from States *C* and *E* together to that of the appeared candidates from States *A* and *F* together?

(a) 17:33 (b) 11:13
(c) 13:27 (d) 17:27
(e) None of these

(ii) In which State, the percentage of qualified candidates with respect to that of appeared candidates is minimum?

(a) *C* (b) *F*
(c) *D* (d) *E*
(e) *G*

(iii) What is the difference between the number of qualified candidates' of States *D* and those of *G*?

(a) 690 (b) 670
(c) 780 (d) 720
(e) None of these

(iv) What is the percentage of qualified candidates with respect to appeared candidates from States *B* and *C* taken together? (rounded to two decimal places)

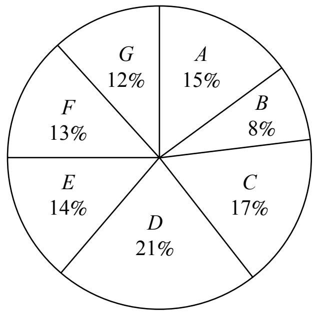
(a) 23.11 (b) 24.21
(c) 21.24 (d) 23
(e) None of these

(v) What is the ratio between the number of candidates qualified from States *B* and *D* together to the number of candidates appeared from State '*C*', respectively?

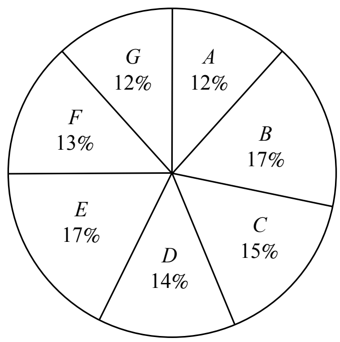
(a) 8:37 (b) 11:12
(c) 37:40 (d) 7:37
(e) None of these

**28.** Directions: These questions are based on the following graphs:

**Distribution of candidates studying Arts and Commerce from seven different institutes *A*, *B*, *C*, *D*, *E*, *F* and *G*. Total Number of Students Studying Arts = 3800**




**Total Number of Students Studying Commerce = 4200**




(i) What is the ratio between the number of students studying Arts from Institute *E* and the number of students studying Commerce from Institute *D*, respectively?

(a) 17:19 (b) 19:27
(c) 14:19 (d) 19:21
(e) None of these

(ii) What is the total number of students studying Arts from Institutes *A* and *G*. together?

(a) 1102 (b) 918
(c) 966 (d) 1130
(e) None of these

(iii) How many students are studying Commerce from Institutes *B* and *D* together?

(a) 1158 (b) 1302
(c) 1232 (d) 1272
(e) None of these

(iv) How many students are studying Art and Commerce from Institute '*B*'?

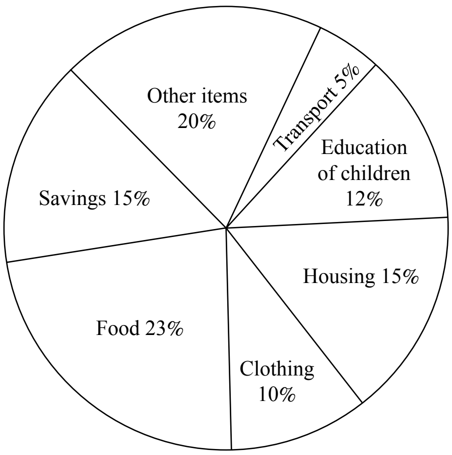
(a) 1418 (b) 2000
(c) 1018 (d) 1208
(e) None of these

(v) What is the ratio between the number of students studying Arts and Commerce, respectively from Institute '*E*'?

(A) 19:27 (b) 17:29
(c) 19:29 (d) 17:27
(e) None of these

**29.** Directions: The pie-chart drawn below shows the expenses of a family on various items and its savings during the year 2001. Study the graph and answer the questions given below:

**Percentage of Money Spent on Various Items and Savings by a Family during 2001**




(i) Maximum expenditure of the family was on

(a) Food (b) Housing
(c) Education of Children (d) Other items

(ii) The total savings of the family for the year were equal to the expenditure on:

(a) Food
(b) Clothing
(c) Housing
(d) Other items including transport

(iii) What per cent of the income was spent on transport and other items together?

(a) 25% (b) 20%
(c) 30% (d) 32%

(iv) If the total income of the family was ₹100000, how much money was spent on the eduction of children?

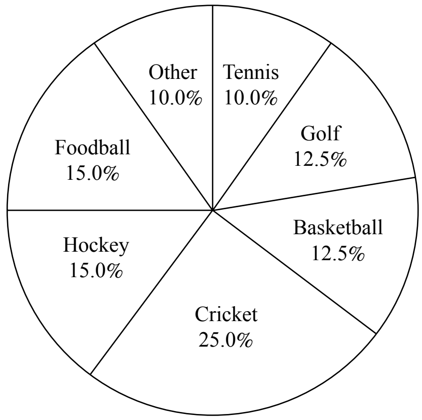
(a) ₹10000 (b) ₹12000
(c) ₹15000 (d) ₹23000

(v) If the total income for the year was ₹100000, the difference of the expenses (in rupees) between housing and transport was:

(a) 15000 (b) 12000
(c) 7000 (d) 10000

**30.** Directions: The circle graph given here shows the spendings of a country on various sports during a year. Study the graph carefully to answer these questions.

**Percent of Money Spent on Various Sports for One Year**




(i) If the total amount spent on sports during the year was ₹15000000, then the amount spent on Cricket and Hockey together was:

(a) ₹6000000 (b) ₹5000000
(c) ₹3750000 (d) ₹7500000

(ii) If the total amount spent during the year was ₹1,20,00,000 how much was spent on basketball?

(a) ₹12,50,000 (b) ₹10,00,000
(c) ₹12,00,000 (d) ₹15,00,000

(iii) The ratio of the total amount spent on football to that spent on Hockey was:

(a) 1:15 (b) 1:1
(c) 15:1 (d) 3:2

(iv) The graph shows that the most popular game is:

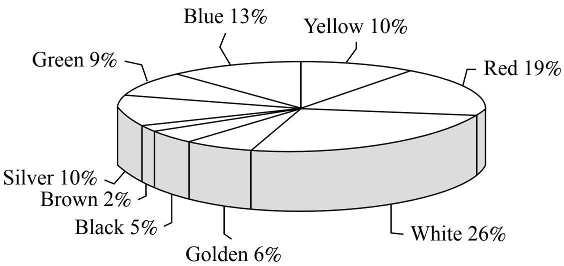
(a) Hockey (b) Football
(c) Cricket (d) Basketball

(v) The country spent the same amount of money on:

(a) Hockey and Tennis (b) Golf and Basketball
(c) Cricket and Football (d) Hockey and Golf.

**31.** Directions: Study the chart and give the answers of following questions.

**Selling of cars in UK according to their colours**




(i) 50% of all the cars consisted of which colours of car?

(a) Black, Golden, Blue, Red,

(b) Blue, Black, Red, Silver

(c) White, Golden, Blue, Black

(d) White, Blue, Green, Black

(e) None of these

(ii) Cars of which colour are 20% less popular than white coloured cars?

(a) Black (b) Golden
(c) Red (d) Blue
(e) None of these

(iii) Cars of which colour are 13% less popular than white coloured cars?

(a) Blue (b) Green
(c) Silver (d) Yellow
(e) None of these

(iv) Cars of which colour when increased by two percent and then combined with that of red cars will make 30 per cent of the total?

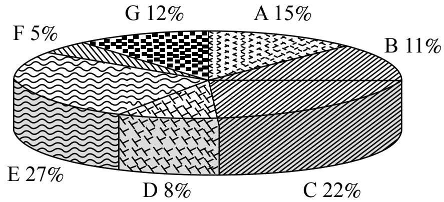
(a) Golden (b) Blue
(c) Black (d) Yellow
(e) None of these

(v) If in a certain period the total production of all cars was 95400 then how many more blue cars were sold than green?

(a) 2580 (b) 3618
(c) 2850 (d) 3816
(e) None of these

**32.** Directions: Seven companies $A$, $B$, $C$, $D$, $E$, $F$ and $G$ are engaged in production of two items I and II. The comparative data about production of these items by the seven companies is given in the following graph and Table. Study them carefully and answer the questions given below.

**Percentage of the total production produced by the seven companies**




**Cost of the total production (both items together) by seven companies = ₹25 crores**

**Ratio of production between items I and II and the per cent profit earned for the two items.**

| Company | Ratio of Production | | Per cent profit earned | |
|---|---|---|---|---|
| | Item I | Item II | Item I | Item II |
| $A$ | 2 | 3 | 25 | 20 |
| $B$ | 3 | 2 | 32 | 35 |
| $C$ | 4 | 1 | 20 | 22 |
| $D$ | 3 | 5 | 15 | 25 |
| $E$ | 5 | 3 | 28 | 30 |
| $F$ | 1 | 4 | 35 | 25 |
| $G$ | 1 | 2 | 30 | 24 |

(i) What is the total cost of the production of item I by companies $A$ and $C$ together in ₹crore?

(a) 9.25 (b) 5.9
(c) 4.1625 (d) 4.9
(e) None of these

(ii) What is the amount of profit earned by company $D$ on item II?

(a) ₹3.125 Crore (b) ₹31.25 Crore
(c) ₹3.125 Lakhs (d) ₹31.25 Lakhs
(e) None of these

(iii) Cost of production of item I by company $F$ is what per cent of the cost of production of item II by company $D$?

(a) 16% (b) 33.33%
(c) 66.67% (d) 12.5%
(e) None of these

(iv) What is total profit earned by company $G$ for items I and II together?

(a) ₹78 Lakhs (b) ₹1.62 Crore
(c) ₹7.8 Crore (d) ₹16.2 Lakhs
(e) None of these

(v) What is the ratio of the cost of production of item I by company $A$ to the cost of production of item I by company $D$?

(a) 3:5 (b) 1:2
(c) 2:1 (d) 2:3
(e) None of these

(vi) What is the total of the profit earned by company *B* on production of item I and the profit earned by company *A* on production of item II?

(a) ₹9.78 Crore (b) ₹97.8 Lakhs
(c) ₹52.8 Lakhs (d) ₹5.28 Crore
(e) None of these

(vii) The cost of production of both items together by company *E* is equal to the total cost of production of both items together by which of the two companies?

(a) *C* and *D* (b) *B* and *G*
(c) *A* and *D* (d) *C* and *F*
(e) *A* and *B*

(viii) What is the total of the cost of production of item I by company *A* and the cost of production of item II by company *B*?

(a) ₹2.6 Crore (b) ₹26 Lakhs
(c) ₹3. 35 Crores (d) ₹33. 65 Lakhs
(e) None of these

**33.** Directions: Study the following information to answer the given questions.

**Percentage of students in various courses (*A*, *B*, *C*, *D*, *E*, *F*) in pie chart I and percentage of girls in pie chart II.**
**Total students: 1200 (800 girls + 4000 boys)**

**Chart I**

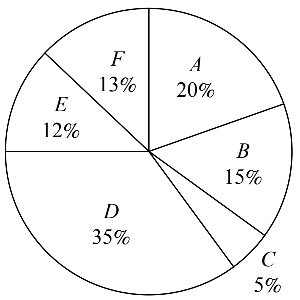
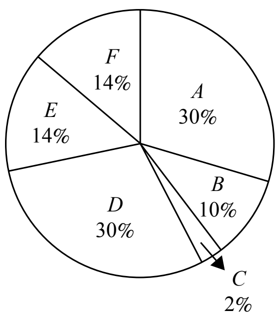



**Chart II**




(i) For course *D*, what is the respective ratio of boys and girls?

(a) 3:4 (b) 4:5
(c) 3:5 (d) 5:6
(e) None of these

(ii) For which pair of courses is the number of boys the same?

(a) *E* and *F* (b) *A* and *D*
(c) *C* and *F* (d) *B* and *D*
(e) None of these

(iii) For course *E,* the number of girls is how much per cent more than the number of boys for course *E*?

(a) 250 (b) 350
(c) 150 (d) 80
(e) None of these

(iv) For which course is the number of boys the minimum?

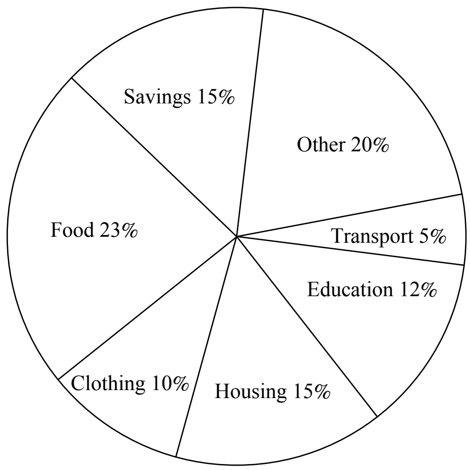
(a) *E* (b) *F*
(c) *C* (d) *A*
(e) None of these

(v) How many girls are there in course *C*?

(a) 44 (b) 16
(d) 40 (e) 160
(e) None of these

**34.** Directions: The circle graph given here shows the spendings by a family on various items during the year 1999 Study the graph and answer these questions.

**Per cent of money spent by a family on various items during 1999**




(i) If the total amount spent during the year 1999 was ₹46000, the amount spent on food was:

(a) ₹2000 (b) ₹10580
(c) ₹23000 (d) ₹2300

(ii) If the total amount spent was ₹46000, how much money was spent on clothing and housing together?

(a) ₹11500 (b) ₹1150
(c) ₹10000 (d) ₹15000

(iii) The ratio of the total amount of money spent on housing to that spent on education was:

(a) 5:2 (b) 2:5
(c) 4:5 (d) 5:4

(iv) Graph shows that the maximum amount was spent on:

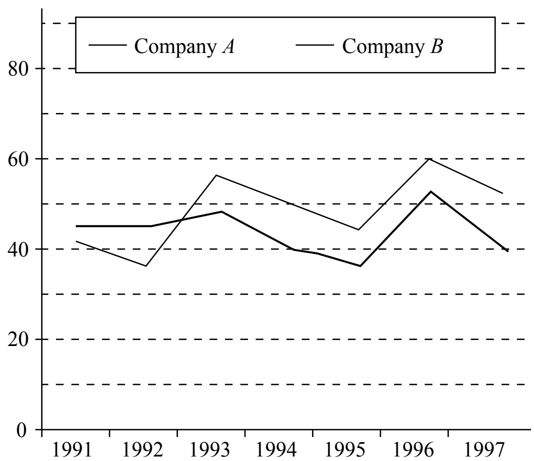
(a) Food (b) Housing
(c) Clothing (d) Others

(v) If the total expenditure of the family for the year 1999 was ₹46000, the family saved during the year:

(a) ₹1500 (b) ₹15000
(c) ₹6900 (d) ₹3067 approx

**35.** Directions: Study the following graph carefully and answer the questions given below.

**Percentage net profit of two companies over the years**




(i) If the total income in 1992 for Company *B* was 140 crores, what was the total expenditure in that year?

(a) 100 Crores (b) 110 Crores
(c) 98 Crores (d) Data inadequate
(e) None of these

(ii) If the total expenditure of 1993 and 1994 together of Company *B* was ₹279 crore, what was the total income in these years?

(a) ₹121.5 Crores (b) ₹135 Crores
(c) ₹140 Crores (d) Data inadequate
(e) None of these

(iii) In how many of the given years the percentage of expenditure to the income of Company *A* was less than fifty?

(a) One (b) Two
(c) Three (d) Four
(e) None of these

(iv) If the total expenditue of Company *B* in 1994 was ₹200 crore, what was the total income?

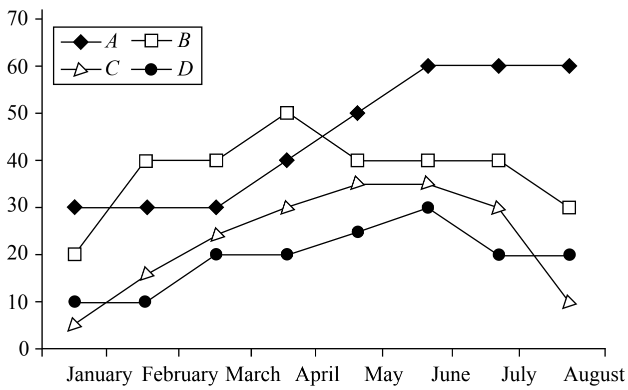
(a) ₹160 Crores (b) ₹240 Crores
(c) ₹260 Crores (d) Data inadequate
(e) None of these

(v) In which of the following years was the total income more than double the total expenditure in that year for Company *B*?

(a) 1995 (b) 1993
(c) 1997 (d) 1992
(e) None of these

**36.** Directions: Study the following graph carefully and answer the questions given below

**Percentage increase in the sale of four commodities *A*, *B*, *C* and *D* for the given months**




(i) For which months did the sale of commodities *A* and *D* show increase?

(a) April only
(b) May and June only
(c) May, June and July only
(d) April, May and June only
(e) None of these

(ii) In which month is the average percentage increase for the four commodities the lowest? (Those months where decrease rook place to be ignored)

(a) May (b) March
(c) January (d) June
(e) None of these

(iii) In which month(s) did all the commodities show decline or no increase from the previous months?

(a) July only
(b) August only
(c) April and July only
(d) July and August only
(e) None of these

(iv) If the sale of $C$ was 100 in May, what was its sale in July?

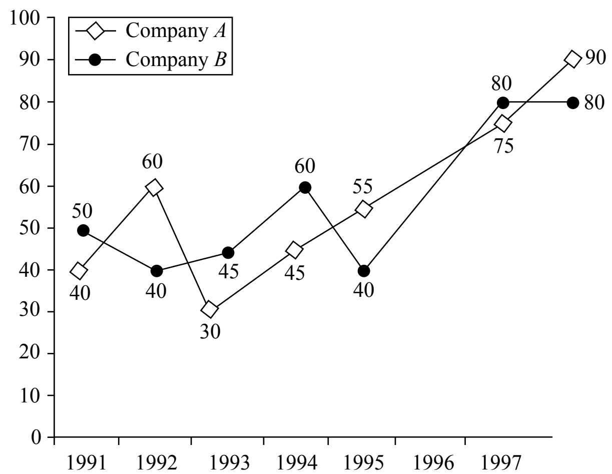
(a) 195 (b) 100
(c) 90 (d) Cannot be determined
(e) None of these

(v) For which commodity is the per cent increase in sale the highest in May from January?

(a) $C$ (b) $A$
(c) $B$ (d) $A$ and $B$
(e) None of these

**37.** Directions: Study the following graph carefully and answer the questions given below it.

**Per cent profit earned by two companies *A* and *B* over the years 1991 to 1997**




(i) Investment of company '$B$' in 1997 is more by 40% than that in the previous year. Income in 1997 was what per cent of the investment in 1996?

(a) 280% (b) 252%
(c) 242% (d) 52%
(e) None of these

(ii) Average investment of company '$A$' over the years was ₹26 Lakhs. What was its average income over the years?

(a) ₹40.56 Lakhs (b) ₹41.60 Lakhs
(c) ₹50.26 Lakhs (d) Data inadequate
(e) None of these

(iii) Income of company '$A$' in 1995 was ₹21.7 Lakh. What was the investment?

(a) ₹14.5 Lakhs (b) ₹15.4 Lakhs
(c) ₹15.8 Lakhs (d) ₹14.6 Lakhs
(e) None of these

(iv) Income of company '$A$' in 1995 is equal to the investment of the company '$B$' in 1996. What is the ratio of the investment of company '$A$' in 1995 to the investment of company '$B$' in 1996?

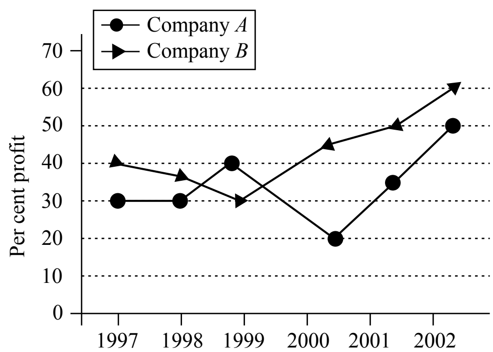
(a) 31:36 (b) 31:20
(c) 20:31 (d) Data inadequate
(e) None of these

(v) Investment of company '$B$' in 1993 was ₹1540000. What was its income in that year?

(a) ₹23.33 Lakhs (b) ₹22.33 Lakhs
(d) ₹22.23 Lakhs (d) ₹23.23 Lakhs
(e) None of these

**38.** Directions: Study the following graph to answer the given questions.

**Per cent profit earned by two companies over the given years**




(i) If the expenditure of Company $B$ in 2000 was ₹200 crore, what was its income?

(a) ₹240 crore (b) ₹220 crore
(c) ₹160 crore (d) Cannot be determined
(e) None of these

(ii) If the income of Company $A$ in 2002 was ₹600 crore, what was its expenditure?

(a) ₹360 corer (b) ₹480 corer
(c) ₹375 corer (d) Cannot be determined
(e) None of these

(iii) If the income of Company $B$ in 1998 was ₹200 crores, what was its profit in 1999?

(a) ₹21.5 corer (b) ₹153 crore
(c) ₹46.15 crore (d) Cannot be determined
(e) None of these

(iv) If the income of the two companies in 1998 were equal, what was the ratio of their expenditures?

(a) 1:2 (b) 26:27
(c) 100:67 (d) Cannot be determined
(e) None of these

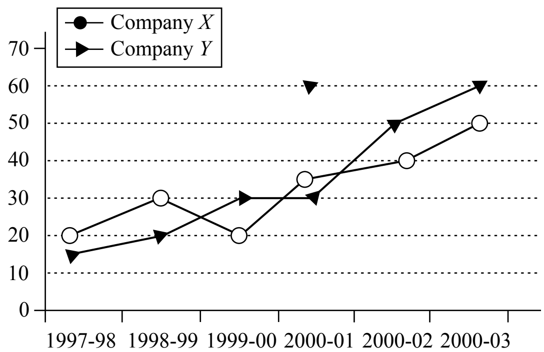
(v) What is the percent increase in profit for company *B* from year 2000 to 2001?

(a) 75 (b) 175
(c) 42.86 (d) Cannot be determined
(e) None of these

**39.** Directions: Study the following graph to answer the given questions.

**Per cent profit earned by two companies over the given years**

$$\textbf{\% profit} = \frac{\text{Income} - \text{Expenditure}}{\text{Expenditure}} \times 100$$




(i) If the income of Company *X* in 1998–99 was equal to the expenditure of Company *Y* in 2001–2002, what was the ratio of their respective profits?

(a) 13:15 (b) 15:26
(c) 13:26 (d) Cannot be determined
(e) None of these

(ii) For Company *X,* its income in 2001–2002 was equal to its expenditure in 2002–2003, what was the ratio of its respective incomes in these two years?

(a) 4:5 (b) 3:4
(c) 2:3 (d) Cannot be determined
(e) None of these

(iii) For Company *Y*, in which year is the per cent of increase in per cent profit over that of previous year the highest?

(a) 2002–03 (b) 1999–2000
(c) 2001–02 (d) Cannot be determined
(e) None of these

(iv) In 1997–98, the expenditure of Company *X* was ₹40 crores. What was its income in that year?

(a) ₹50 crore (b) ₹48 crore
(c) ₹46 crore (d) Cannot be determined
(e) None of these

(v) What was the difference in the expenditures of the two companies in 1999–2000?

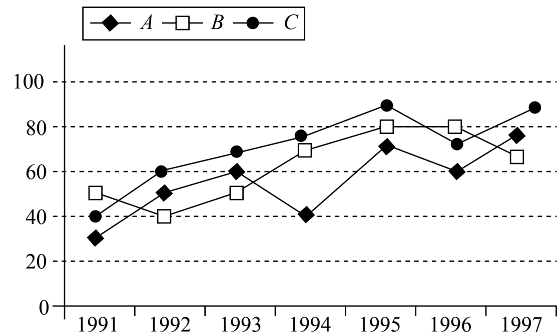
(a) 10 (b) 100
(c) 1000 (d) Cannot be determined
(e) None of these

(vi) In 2002–03 the income of Company *Y* was ₹128 crores. What was its expenditure in that year?

(a) ₹76.8 crore (b) ₹64 crore
(c) ₹48 crore (d) Cannot be determined
(e) None of these

**40.** Directions: Study the following graph carefully and answer the questions given below it.

**Imports of 3 companies over the years (₹ in crore)**




(i) In which of the following years, the imports made by Company *A* was exactly equal to average imports made by it over the given years?

(a) 1992 (b) 1993
(c) 1994 (d) 1995
(e) None of these

(ii) In which of the following years was the difference between the imports made by Company *B* and *C* the maximum?

(a) 1995 (b) 1994
(c) 1991 (d) 1992
(e) None of these

(iii) In which of the following years was the imports made by Company *A* exactly half of the total imports made by Company *B* and *C* together in that year?

(a) 1992 only (b) 1993 only
(c) 1992 and 1993 (d) 1995 only
(e) None of these

(iv) What was the percentage increase in imports by Company *B* from 1992 to 1993?

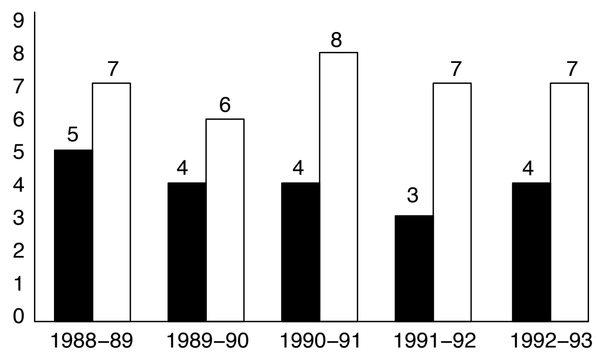
(a) 10 (b) 25
(c) 40 (d) 20
(e) None of these

(v) In which of the following years was the total imports made by all the three companies together the maximum?

(a) 1996 only (b) 1997 only
(c) 1995 only (d) 1995 and 1997 only
(e) None of these

## EXERCISE-2
## (BASED ON MEMORY)

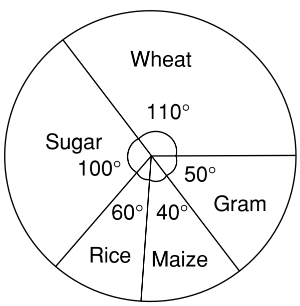
**1.** The average Kharif production of the given years is production of pulses in Rabi and Kharif season (in million tonnes)




(a) 4 million tonnes (b) 5 million tonnes
(c) 4.5 million tonnes (d) 5.5 million tonnes

**[SSC, 2013]**

**Directions (Question 2):** The annual agricultural production (in tonnes) of an Indian state is given in the pie chart. The total production is 9000 tonnes. Read the pie chart and answer the question.

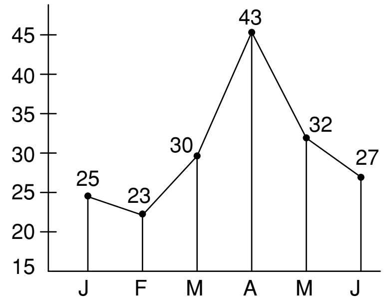



**2.** What is the annual production of wheat?

(a) 2750 tonnes (b) 3000 tonnes
(c) 3540 tonnes (d) 3500 tonnes

**[SSC, 2013]**

**3.** Given is a line graph showing the number of accidents in a city during the first 6 months of 1999.



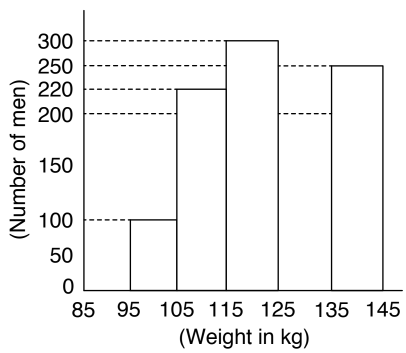

The decrease percentage of accidents from May to June is

(a) $15\frac{3}{8}\%$ (b) $15\frac{1}{8}\%$

(c) $15\frac{5}{8}\%$ (d) $15\frac{7}{8}\%$

**[SSC, 2013]**

**Directions (Question 4):** Study the histogram of weight distribution of different men and answer the question.

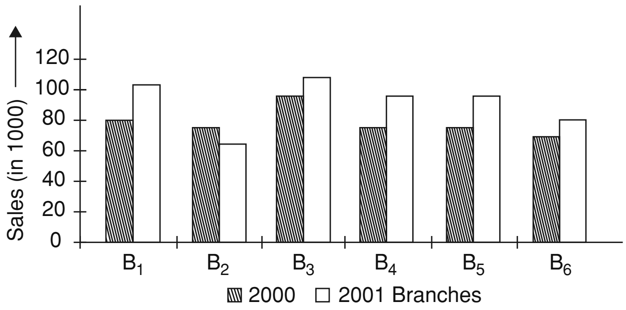



**4.** Average number of men per interval who participated in this survey is:

(a) 200 (b) 180
(c) 214 (d) 194

**[SSC, 2013]**

**Directions (Question 5 to 8):** Bar chart showing the sales of books (in 1000) from six branches $B_1$, $B_2$, $B_3$, $B_4$, $B_5$ and $B_6$ of a publishing company in 2000 and 2001 is given below. Study the chart and answer the questions.




**[SSC Assistant Grade III, 2013]**

5. Total sales of Branch $B_6$ for both the years is what per cent of the total sales of Branch $B_3$ for both the years?

(a) 71.11% (b) 73.17%
(c) 68.54% (d) 77.26%

**[SSC Assistant Grade III, 2013]**

6. What is the ratio of the total sales of Branch $B_2$ for both the years to the total sales of Branch $B_4$ for both the years?

(a) 2:3 (b) 3:5
(c) 5:7 (d) 7:9

**[SSC Assistant Grade III, 2013]**

7. What percent of the average sales of branches $B_1$, $B_2$ and $B_3$ in 2001 is the average sales of branches $B_1$, $B_3$ and $B_6$ in 2000?

(a) 107.28% (b) 104.28%
(c) 117.28% (d) 114.28%

**[SSC Assistant Grade III, 2013]**

8. What is the average sale of books from all the branches for the year 2000?

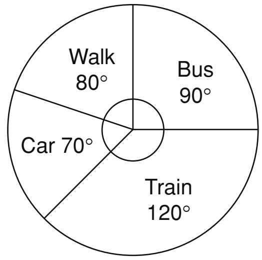
(a) 70 (b) 80
(c) 70.5 (d) 80.5

**[SSC Assistant Grade III, 2013]**

**Directions (Question 9 to 13):** The pie chart given below represents the number of students using different transport to a school in which total number of students is 2160.

Answer the questions based on the following diagram.

**[SSC Assistant Grade III, 2013]**




9. The total number of students who come to school by car is:

(a) 70 (b) 290
(c) 420 (d) 480

**[SSC Assistant Grade III, 2013]**

10. The ratio of the total number of students who come to school by car to the total number of students who come to school by bus is:

(a) 21:24 (b) 21:27
(c) 36:27 (d) 36:21

**[SSC Assistant Grade III, 2013]**

11. The total number of students coming to school either by walking or by bus is:

(a) 480 (b) 540
(c) 1020 (d) 170

**[SSC Assistant Grade III, 2013]**

12. The total number of students who don't come to school by train is:

(a) 720 (b) 1020
(c) 2040 (d) 1440

**[SSC Assistant Grade III, 2013]**

13. The total number of students coming to school by bus exceeds the total number of students coming to school by walking, by:

(a) 10% (b) 12.5%
(c) 11% (d) 11.5%

**[SSC Assistant Grade III, 2013]**

**Directions (Question 14 to 17):** Study the following table and answer the questions.

Number of students from various schools playing various games (one student playsone game only)

| | School | | | | |
|---|---|---|---|---|---|
| **Games** | **A** | **B** | **C** | **D** | **E** |
| Cricket | 150 | 200 | 250 | 230 | 200 |
| Football | 250 | 125 | 175 | 100 | 250 |
| Basketball | 200 | 195 | 245 | 200 | 225 |
| Badminton | 100 | 130 | 60 | 40 | 65 |
| Tennis | 120 | 180 | 150 | 130 | 165 |

**14.** The difference between the total number of students playing Basketball from all the school and the total number of students playing Cricket from all the schools is:

(a) 27 (b) 35
(c) 28 (d) 26

**[SSC Assistant Grade III, 2012]**

**15.** The number of students playing Football from School C is $x$ per cent of the total number of students playing Football from all the schools. Then$x$ equals

(a) $19\frac{7}{9}$ (b) $19\frac{4}{9}$

(c) 18 (d) $20\frac{2}{9}$

**[SSC Assistant Grade III, 2012]**

**16.** Which school has the maximum number of players?

(a) A (b) B
(c) C (d) E

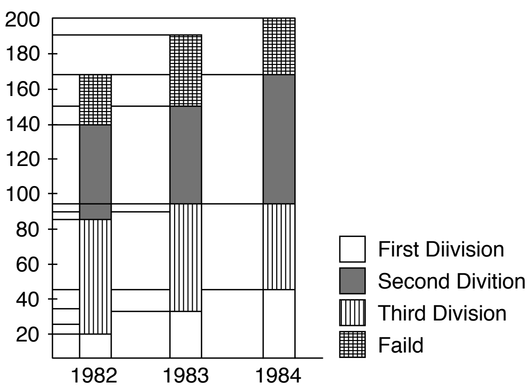
**[SSC Assistant Grade III, 2012]**

**17.** The number of students playing Badminton from School E is $x$ % of the students playing Badminton from School B. Then $x$ equals:

(a) 40 (b) 50
(c) 42 (d) 41

**[SSC Assistant Grade III, 2012]**

**Directions (Question 18 to 22):** The following bar graph depicts the result for BSc students of a college for three years. Read the graph and answer the questions based on this graph.




**18.** The number of students passed in third division in 1984 was

(a) 165 (b) 75
(c) 70 (d) 65

**[SSC Assistant Grade III, 2012]**

**19.** The percentage of students failed in 1984 was

(a) $18\frac{1}{2}\%$ (b) $17\frac{3}{4}\%$

(c) $17\frac{1}{2}\%$ (d) 17%

**[SSC Assistant Grade III, 2012]**

**20.** The aggregate pass percentage during the three years was

(a) $82\frac{44}{113}\%$ (b) $82\frac{55}{113}\%$

(c) $80\frac{60}{113}\%$ (d) $77\frac{29}{113}\%$

**[SSC Assistant Grade III, 2012]**

**21.** The percentage of students passed in first division in 1982 was

(a) 20% (b) 34%

(c) $14\frac{2}{7}\%$ (d) $11\frac{13}{17}\%$

**[SSC Assistant Grade III, 2012]**

**22.** The percentage of students passed in 1982 was

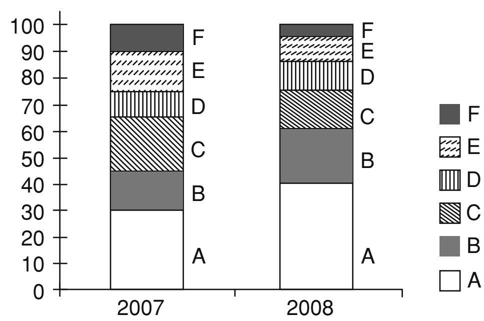
(a) 65% (b) 70%

(c) $74\frac{2}{17}\%$ (d) $82\frac{6}{17}\%$

**[SSC Assistant Grade III, 2012]**

**Directions (Question 23 to 27):** The bar chart given below shows the percentage distribution of the production of various models of a mobile manufacturing company in 2007 and 2008. The total production in 2007 was 35 Lakh mobile phones and in 2008 the production was 44 Lakhs. Study the chart and answer the following questions.

Percentage of six different types of mobiles manufactured by a company over two years




**23.** Total number of mobiles of models A, B and E manufactured in 2007 was

(a) 24,50,000 (b) 22,75,000
(c) 21,00,000 (d) 19,25,000

**[SSC, 2012]**

**24.** For which models was the percentage variation in production from 2007 to 2008 the maximum?

(a) B and C (b) C and D
(c) D and E (d) A and B

**[SSC, 2012]**

**25.** What was the difference in the number of B type mobiles produced in 2007 and 2008?

(a) 3,55,000 (b) 2,70,000
(c) 2,25,000 (d) 1,75,000

**[SSC, 2012]**

**26.** If the percentage production of A type mobiles in 2008 was same as that in 2007, then the number of A type mobiles produced in 2008 would have been

(a) 14,00,000 (b) 13,20,000
(c) 11,70,000 (d) 10,50,000

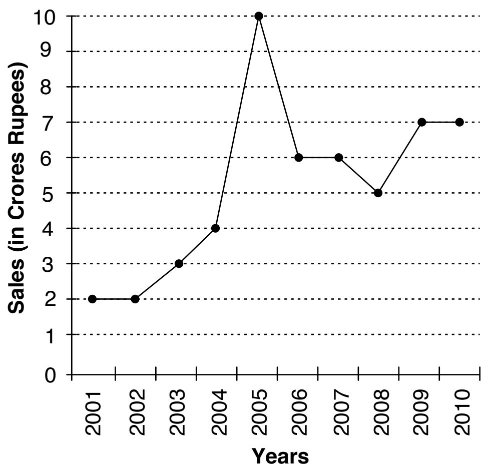
**[SSC, 2012]**

**27.** If 85% of the D type mobiles produced in each year were sold by the company, how many D type mobiles remained unsold?

(a) 76,500 (b) 93,500
(c) 1,18,500 (d) 1,22,500

**[SSC, 2012]**

**Directions (Question. 28 to 32):** The following line-diagram represents the yearly sales figures of a company in the years 2001–2010. Examine the diagram and answer the questions 81 to 85.




**28.** By what per cent did the sales in 2008 decrease in comparison to the sales in 2006?

(a) 20 (b) 18
(c) $16\frac{2}{3}$ (d) $15\frac{2}{3}$

**[SSC, 2011]**

**29.** The ratio of sales in 2002 to that in 2007 is:

(a) 2:3 (b) 1:3
(c) 1:1 (d) 3:2

**[SSC, 2011]**

**30.** Average sale (in crores) of the company during the period 2003–2007 is:

(a) 5.8 (b) 5
(c) 6 (d) 5.5

**[SSC, 2011]**

**31.** The percentage increase in sales in the year 2005 with respect to the previous year is:

(a) 80 (b) 100
(c) 120 (d) 150

**[SSC, 2011]**

**32.** Total sales (in crores of) from 2005 to 2008 is:

(a) 17 (b) 27
(c) 22 (d) 31

**[SSC, 2011]**

**Directions (Question 33 to 37):** The following table shows the number of students of seven colleges participating in extra-curricular activities:

| Extra-Curricular Activity | Colleges | | | | | | |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G |
| I | 200 | 300 | 500 | 100 | 400 | 300 | 200 |
| II | 100 | 200 | 200 | 100 | 100 | 100 | 100 |
| III | 65 | 130 | 420 | 75 | 540 | 220 | 153 |
| IV | 317 | 155 | 438 | 105 | 385 | 280 | 120 |

**Read the table and answer the questions given below:**

**33.** The difference of the range of number of students in activity IV and the average is of number of students in activity III per college is:

(a) 111 (b) 153
(c) 104 (d) 217

**[SSC, 2011]**

**34.** Percentage of the number of students in activity II to that of IV is:

(a) 37 (b) 42
(c) 48 (d) 50

**[SSC, 2011]**

**35.** The median of data pertaining to activity III is:

(a) 540 (b) 229
(c) 153 (d) 75

**[SSC, 2011]**

**36.** The college in which minimum number of students participate in extra-curricular activities is:

(a) D (b) G
(c) F (d) A

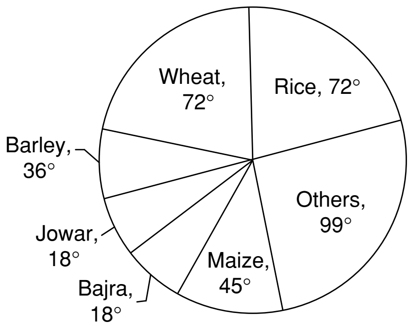
**[SSC, 2011]**

**37.** The ratio of total number of students in II and I is:

(a) 1:2 (b) 9:20
(c) 19:7 (d) 21:10

**[SSC, 2011]**

**Directions (Question 38 to 42):** The pie-chart provided below gives the distribution of land (in a village) under various food crops. Study the pie-chart carefully and answer the questions that follow:




**38.** If the total area under bajra was three hundred acres, then the total area (in hundred acres) under rice and barely together is:

(a) 18 (b) 12
(c) 15 (d) 20

**[SSC, 2011]**

**39.** The combination of three crops which contribute to more than 50% of the total area under the food crops is:

(a) Wheat, rice and maize
(b) Wheat, rice and jowar
(c) Wheat, rice and bajra
(d) Rice, barley and maize

**[SSC, 2011]**

**40.** The ratio of the land used for rice and barley is:

(a) 3:1 (b) 1:2
(c) 2:1 (d) 3:2

**[SSC, 2011]**

**41.** If 10% of the land reserved for rice be distributed to wheat and barley in the ratio 2:1, then the angle corresponding to wheat in the new pie-chart will be:

(a) 38.4° (b) 76.8°
(c) 75.6° (d) 45.5°

**[SSC, 2011]**

**42.** If the production of rice is 5 times that of jowar and the production of jowar is 2 times that of bajra, then the ratio between the yield per acre of rice and bajra is:

(a) 5:2 (b) 3:1
(c) 4:1 (d) 6:1

**[SSC, 2011]**

**Directions (Question 43 to 47):** The bar graph provided below represents the production of rice and wheat in different states of a country in a certain year. Answer the question given below based on the bar graph.


**43.** The total production of rice and wheat in all the mentioned states is minimum in the state _____.

(a) B (b) C
(c) D (d) E

**[SSC, 2011]**

**44.** The ratio of total production of rice in the mentioned states to that of wheat in those states, is:

(a) 15:16 (b) 12:13
(c) 13:14 (d) 14:15

**[SSC, 2011]**

**45.** The difference between the production in rice and wheat is maximum in:

(a) A only (b) All of A, B and E
(c) B and E both (d) A and B both

**[SSC, 2011]**

**46.** The state which is the largest producer of rice is:

(a) A (b) B
(c) C (d) D

**[SSC, 2011]**

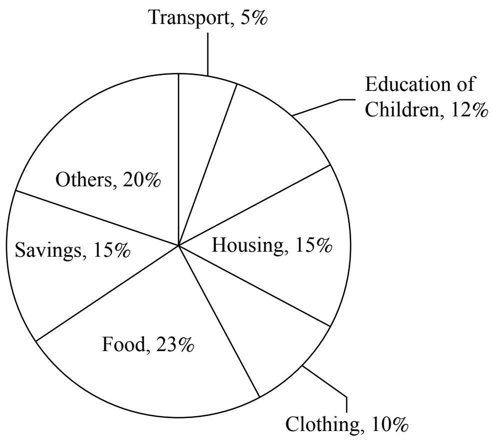
**47.** The average of production of rice in the mentioned states (in lakh tonnes) is:

(a) 5.5 (b) 5.6
(c) 5.7 (d) 5.8

**[SSC, 2011]**

**Directions (Question 48 to 52):** The pie-chart given below, shows the expenditure on various items and savings of a family during the year 2009. Study the pie-chart and answer the questions based on it.

Percentage of money spent on various items and savings by a family during 2009




**48.** If the total income of the family for the year 2009 was ₹1,50,000 then the difference between the expenditures on housing and transport was:

(a) ₹15,000 (b) ₹10,000
(c) ₹12,000 (d) ₹7,500

**[SSC, 2010]**

**49.** Maximum expenditure of the family other than on food, was on:

(a) Housing (b) Clothing
(c) Others (d) Education of children

**[SSC, 2010]**

**50.** The savings of the family for the year were equal to the expenditure on:

(a) Food (b) Housing
(c) Education of children (d) Clothing

**[SSC, 2010]**

**51.** The percentage of the income which was spent on clothing, education of children and transport together is:

(a) 17 (b) 20
(c) 22 (d) 27

**[SSC, 2010]**

**52.** If the total income of the family was ₹1,50,000 then the money spent on food was:

(a) ₹20,000 (b) ₹23,000
(c) ₹30,000 (d) ₹34,500

**[SSC, 2010]**

**Directions (Question 53 to 58):** Study the bar diagram and answer questions based on it.

Persons killed in industrial accidents

Person killed in coal mines


**53.** The number of persons killed in coal mines in 2006 was what per cent of those killed in industrial accidents in that year?

(a) 4 (b) 25
(c) 36 (d) 300

**[SSC, 2010]**

**54.** In which year, minimum number of persons killed in industrial accidents and coal mines together?

(a) 2006 (b) 2007
(c) 2008 (d) 2009

**[SSC, 2010]**

**55.** In which year, maximum number of persons were killed in industrial accidents other than those killed in coal mines?

(a) 2006 (b) 2007
(c) 2008 (d) 2009

**[SSC, 2010]**

**56.** In which year, minimum number of persons were killed in coal mines other than those killed in industrial accidents?

(a) 2006 (b) 2007
(c) 2008 (d) 2009

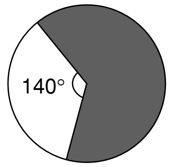
**[SSC, 2010]**

**57.** In a year, on an average, how many persons were killed in industrial accidents and coal mines together?

(a) 121.25 (b) 1212
(c) 1212.5 (d) 1000

**[SSC, 2010]**

**58.** In The figure given below, the perimeter of the circle is 220 cm. What is the area of the shaded portion in cm$^2$?




(a) $2542\frac{7}{9}$ (b) $2584\frac{1}{3}$

(c) $2447\frac{1}{9}$ (d) $2352\frac{7}{9}$

(e) $2376\frac{2}{3}$

**[IBPS PO/MT, 2014]**

**Directions (Question 59 to 63):** Study the table to answer the given questions.

| City | Total population of the city | Percentage of people (male and female) who watch the TV Series out of the total population of the city | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Big Bang Theory | | Arrow | | Breaking Bad | | Mentalist | |
| | | Male | Female | Male | Female | Male | Female | Male | Female |
| P | 40000 | 12 | 14 | 22 | 18 | 18 | 20 | 12 | 10 |
| Q | 20000 | 10 | 20 | 20 | 16 | 14 | 10 | 15 | 30 |
| R | 50000 | 18 | 12 | 10 | 22 | 16 | 12 | 16 | 22 |
| S | 30000 | 16 | 20 | 10 | 20 | 12 | 30 | 18 | 12 |
| T | 50000 | 22 | 30 | 12 | 14 | 20 | 12 | 15 | 20 |

**59.** What is the difference between the total number of people living in City R, Q and T together who do not watch Arrow and the total number of people living in these three cities together who watch Arrow?

(a) 47200 (b) 45300
(c) 47400 (d) 47600
(e) 45600

**[IBPS PO/MT, 2014]**

**60.** What is the average number of males who watch Big Bang Theory in all the cities together?

(a) 6320 (b) 6380
(c) 6340 (d) 6350
(e) 6360

**[IBPS PO/MT, 2014]**

**61.** The ratio of the total number of males to the total number of females in City P is 5:3. What per cent of the female population watches Breaking Bad in City P?

(a) $55\frac{1}{3}$ (b) $55\frac{2}{3}$

(c) $58\frac{1}{3}$ (d) $53\frac{1}{3}$

(e) $53\frac{2}{3}$

**[IBPS PO/MT, 2014]**

**62.** The total population (males and females) of City R watching Mentalist is what per cent more than the total population (male and female) of City T watching the same TV Series?

(a) $8\frac{3}{7}$ (b) $8\frac{5}{7}$

(c) $8\frac{4}{7}$ (d) $7\frac{3}{7}$

(e) $7\frac{4}{7}$

**[IBPS PO/MT, 2014]**

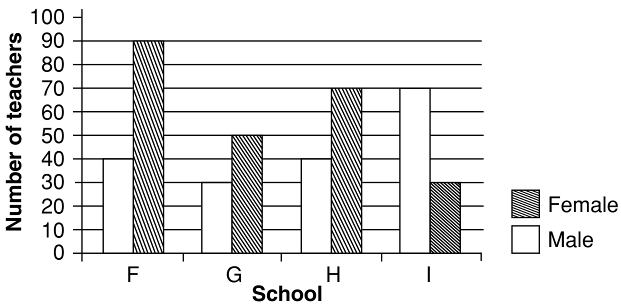
**63.** What is the ratio of the number of females who watch Breaking Bad in City Q and City S together to the number of females who watch Mentalist in the same cities together?

(a) 59:47
(b) 55:48
(c) 59:42
(d) 55:43
(e) 59:45

**[IBPS PO/MT, 2014]**

**Directions (Question 64):** This question is the graph below:

Number of male and female teachers in four schools

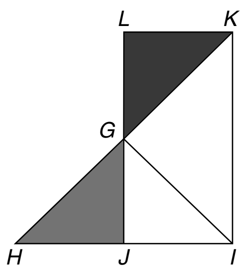



**64.** What is the difference between the average number ofmale and female teachers in the given schools?

(a) 10 (b 20
(c) 5 (d) 25
(e) 15

**[IBPS PO/MT, 2014]**

**65.** In the figure given below GHI is an equilateral triangle with side 14 cm. G is themidpoint of JL. What is the area of the shaded portion(in $cm^2$)?

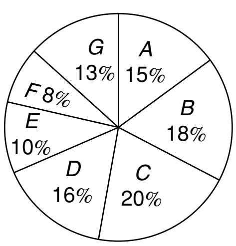



(a) $56\sqrt{3}$ (b) $70\sqrt{3}$
(c) $35\sqrt{3}$ (d) $49\sqrt{3}$
(e) $42\sqrt{3}$

**Directions (Question 66 to 70):** Refer to the pie-chart and answer the given questions:

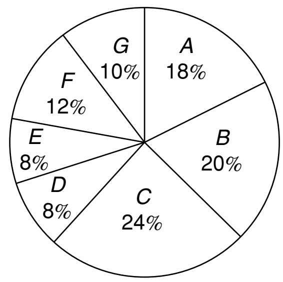
Distribution of the total number of novels (Romantic and Horror) sold by 7 stores

**Total number = 63000**




Distribution of the total number of Romantic novels sold by 7 stores

**Total number = 36000**




**[IBPS PO/MT, 2014]**

**66.** What is the ratio of the number of novels (Romantic and Horror) sold by store E to the total number of Horror novels sold by stores C and F together?

(a) 35:32 (b) 45:32
(c) 35:24 (d) 35:26
(e) 45:34

**[IBPS PO/MT, 2014]**

**67.** What is the average number of Horror novels sold by stores B, C, E and F together?

(a) 2960 (b) 3060
(c) 2680 (d) 3240
(e) 3180

**[IBPS PO/MT, 2014]**

**68.** What is the central angle corresponding to the number of novels (Romantic and Horror) sold by store B?

(a) 68.2° (b) 72.6°
(c) 62.4° (d) 64.8°
(e) 70.8°

**[IBPS PO/MT, 2014]**

**69.** The number of novels (Romantic and Horror) sold by store F is what percent less than the total number of Romantic novels sold by stores B and G together?

(a) $51\frac{2}{3}$ (b) $53\frac{1}{3}$
(c) $55\frac{2}{3}$ (d) $58\frac{1}{3}$
(e) $56\frac{1}{3}$

**[IBPS PO/MT, 2014]**

**70.** What is the difference between the total number of romantic novels sold by stores A, D and G together and the total number of Horror novels sold by the same stores together?

(a) 2000 (b) 1600
(c) 2400 (d) 1800
(e) 2200

**[IBPS PO/MT, 2014]**

**Directions (Question 71–72):** Study the following table to answer the given questions.

Number of girls studying IT and Electronics Engineering from Five colleges

| College | IT | Electronics |
|---|---|---|
| A | 240 | 315 |
| B | 350 | 285 |
| C | 260 | 225 |
| D | 325 | 255 |
| E | 275 | 220 |

**71.** The total number of girls studying IT Engineering from college B, C and D together is by what per cent more than the total number of girls studing Electronics Engineering from these three colleges?

(a) $22\frac{2}{9}$ (b) $23\frac{1}{9}$
(c) $22\frac{2}{3}$ (d) $23\frac{5}{9}$
(e) $23\frac{1}{3}$

**[IBPS PO/MT, 2014]**

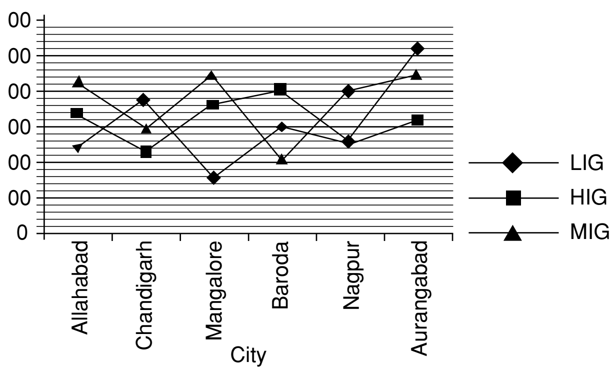
**72.** What per cent of the girls in college C study Electronics Engineering out of the girls studying IT and Electronics Engineering? (Rounded off to the nearest integer)

(a) 46 (b) 52
(c) 51 (d) 42
(e) 49

**[IBPS PO/MT, 2014]**

**Directions (Question 73–77):** Study the following graph carefully to answer the given questions.

Number of the flat booked in HIG, MIG and LIG categories from different cities in 2004.




**73.** If for Aurangabad the number of HIG flats booked in 2005 was more than that in 2004 by 15%, the number of MIG flats booked in 2005 was more than that in 2004 by 10% and the number of LIG flats booked in 2005 was more than that in 2004 by 20% then what was the total number of flats booked in Aurangabad in 2005?

(a) 1565 (b) 1521
(c) 1625 (d) 1642
(e) 1544

**[IBPS PO/MT, 2014]**

**74.** Out of the LIG flats booked from Chandigarh, 35% were by employees of a Financial Institution and out of the remaining flats, those booked by officers from a software company and HRM department of Government of India were in the ratio of 6:7. What was the total no. of LIG flats booked by officers from the software company?

(a) 130 (b) 120
(c) 160 (d) 140
(e) 150

**[IBPS PO/MT, 2014]**

**75.** The total number of MIG flats booked in Mangalore, Baroda and Nagpur is by what per cent more than the total number of LIG flats booked from these three cities together? (Rounded off to the nearest integer)

(a) 37 (b) 35
(c) 39 (d) 32
(e) 34

**[IBPS PO/MT, 2014]**

**76.** What is the difference between the total number of MIG flats booked in Allahabad, Mangalore, Nagpur and Aurangabad together and the total number of LIG flatsbooked in these four cities together?

(a) 420 (b) 480
(c) 460 (d) 360
(e) 260

**[IBPS PO/MT, 2014]**

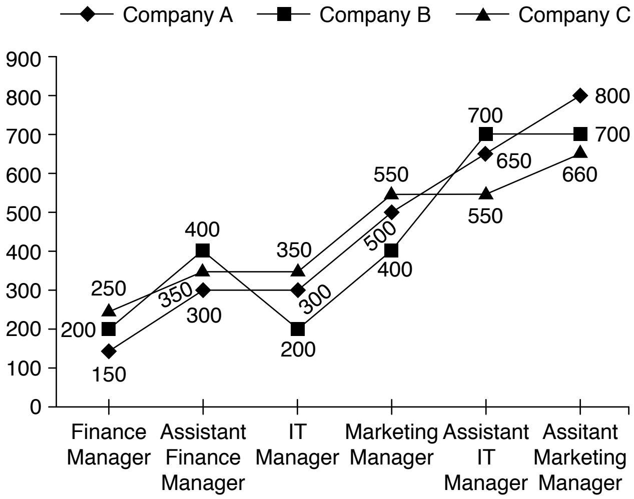
**77.** What is the ratio of the total number of flats (all three types) booked in Allahabad to that in Baroda?

(a) 54:49 (b) 51:46
(c) 54:47 (d) 58:49
(e) 55:48

**[IBPS PO/MT, 2014]**

**Directions (Question 78–82):** Study the following graph carefully to answer the questions given below:

Number of selected employees in different grades/ ranks by three companies during 2012




**78.** What is the average number of selected employees by Company A in all grades taken together?

(a) 450 (b) 460
(c) 475 (d) 375
(e) None of these

**[IBPS PO/MT, 2013]**

**79.** What is the ratio of selected employees for the post of Assistant IT Managers by Companies A, B and C respectively?

(a) 8:10:11 (b) 10:8:11
(c) 11:10:8 (d) 10:11:8
(e) None of these

**[IBPS PO/MT, 2013]**

**80.** By what percent is the number of selected employees for Finance Managers by Company C more than that of the selected employees by Company B for the same post?

(a) 35% (b) 30%
(c) 25% (d) 40%
(e) None of these

**[IBPS PO/MT, 2013]**

**81** What is the average number of selected employees for the post of Assistant Marketing Managers by all companies taken together?

(a) 570 (2) 520
(c) 620 (d) 720
(e) None of these

**[IBPS PO/MT, 2013]**

**82.** What is the ratio of selected employees for IT Managers by all Companies A, B and C?

(a) 6:4:7 (b) 5:3:7
(c) 4:7:9 (d) 8:7:6
(e) None of these

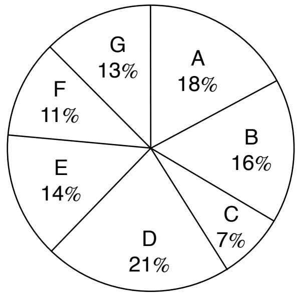
**[IBPS PO/MT, 2013]**

**Directions (Question 83 to 87):** The following questions are based on the pie-charts given below:

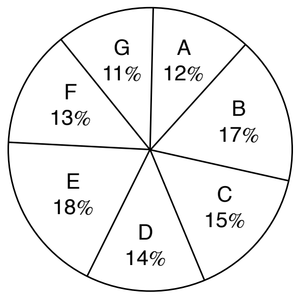
Percentage-wise distribution of students studying in Arts and Commerce in seven different institutions

Different institutions–A, B, C, D, E, F and G

Total number of students studying Arts = 3800




**Total number of students studying Commerce = 4200**




**[IBPS PO/MT, 2013]**

**83.** What is the total number of students studying Arts in Institutes A and G together?

(a) 1026 (b) 1126
(c) 1226 (d) 1206
(e) 1306

**[IBPS PO/MT, 2013]**

**84.** How many students from Institute B study Arts and Commerce?

(a) 1180 (b) 1108
(c) 1018 (d) 1208
(e) 1408

**[IBPS PO/MT, 2013]**

**85.** The ratio of the number of students studying Arts to that studying Commerce in Institute E is:

(a) 27:14 (b) 19:27
(c) 19:16 (d) 19:28
(e) None of these

**[IBPS PO/MT, 2013]**

**86.** The ratio of the number of students studying Arts in Institute E to that studying commerce in Institute D is:

(a) 12:17 (b) 12:7
(c) 19:21 (d) 17:19
(e) None of these

**[IBPS PO/MT, 2013]**

**87.** How many students in institutes B and D together study commerce?

(a) 1320
(b) 1302
(c) 1202
(d) 1220
(e) None of these

**[IBPS PO/MT, 2013]**

**Directions (Question 88 to 92):** Study the following table carefully to answer these questions.

Percentage of marks obtained by six students in six different subjects

| Student ↓ Subject → | History (Out of 50) | Geography (Out of 50) | Maths (Out of 150) | Science (Out of 100) | English (Out of 75) | Hindi (Out of 75) |
|---|---|---|---|---|---|---|
| Amit | 76 | 85 | 69 | 73 | 64 | 88 |
| Bharat | 84 | 80 | 85 | 78 | 73 | 92 |
| Umesh | 82 | 67 | 92 | 87 | 69 | 76 |
| Nikhil | 73 | 72 | 78 | 69 | 58 | 83 |
| Pratiksha | 68 | 79 | 64 | 91 | 66 | 65 |
| Ritesh | 79 | 87 | 88 | 93 | 82 | 72 |

**88.** What is the approximate integral percentage of marks obtained by Umesh in all the subjects?

(a) 80% (b) 84%
(c) 86% (d) 78%
(e) 77%

**[IBPS PO/MT, 2013]**

**89.** What is the average percentage of marks obtained by all students in Hindi? (Approximated to two places of decimal)

(a) 77.45% (b) 79.33%
(c) 75.52% (d) 73.52%
(e) None of these

**[IBPS PO/MT, 2013]**

**90.** What is the average mark of all the students in Mathematics?

(a) 128 (b) 112
(c) 119 (d) 138
(e) 144

**[IBPS PO/MT, 2013]**

**91.** What is the average mark obtained by all the students in Geography?

(a) 38.26 (b) 37.26
(c) 37.16 (d) 39.16
(e) None of these

**[IBPS PO/MT, 2013]**

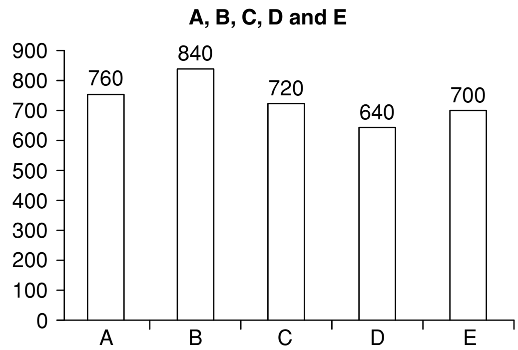
**92.** What is the total mark obtained by Ritesh in all the subjects taken together?

(a) 401.75 (b) 410.75
(c) 402.75 (d) 420.75
(e) None of these

**[IBPS PO/MT, 2013]**

**Directions (Question 93 to 97):** Study the following bar diagram and table carefully to answer the questions.

Number of employees working in five different companies. A,B,C,D and E




**Company**

**Ratio of male to female employees**

| Company | Male:Female |
|---|---|
| A | 13:6 |
| B | 4:3 |
| C | 7:8 |
| D | 9:11 |
| E | 23:12 |

**93.** What is the number of male employees, taking all the Companies together?

(a) 2084 (b) 2048
(c) 2064 (d) 2046
(e) 2066

**[IBPS PO/MT, 2013]**

**94.** What is the approximate average number of female employees, taking all the companies together?

(a) 340 (b) 315
(c) 335 (d) 325
(e) 321

**[IBPS PO/MT, 2013]**

**95.** By what percent is the number of male employeesworking in Company A and C more than that of female employees working in Company B and D?

(a) 164
(b) 146
(c) 144
(d) 154
(e) 184

**[IBPS PO/MT, 2013]**

**96.** What is the ratio of female employees working in Company D and E respectively?

(a) 17:22 (b) 22:17
(c) 15:22 (d) 22:15
(e) None of these

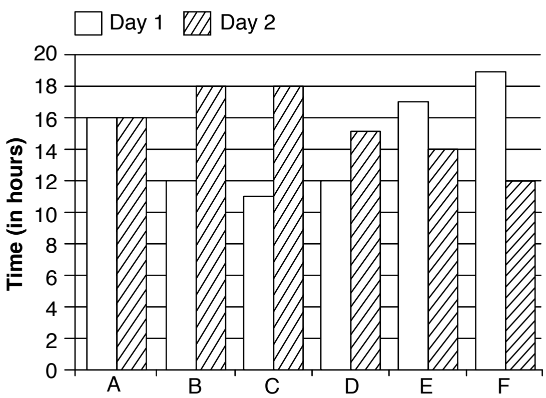
**[IBPS PO/MT, 2013]**

**97.** By what percent is the number of total employees of Company C more than that of Company D?

(a) 12.5% (b) 16.5%
(c) 21% (d) 20%
(e) 16%

**[IBPS PO/MT, 2013]**

**Directions (Question 98 to 102):** Study the following graph and table carefully and answer the questions given below:




Distance covered (in kilometres) by six vehicles on each day

**[IBPS PO/MT, 2012]**

| Vehicle | Day 1 | Day 2 |
|---|---|---|
| A | 832 | 864 |
| B | 516 | 774 |
| C | 693 | 810 |
| D | 552 | 765 |
| E | 935 | 546 |
| F | 703 | 636 |

**98.** Which of the following vehicles travelled at the same speed on both the days?

(a) Vehicle A (b) Vehicle C
(c) Vehicle F (d) Vehicle B
(e) None of these

**[IBPS PO/MT, 2012]**

**99.** What was the difference between the speed of Vehicle A on Day 1 and the speed of Vehicle C on the same day?

(a) 7 Km/h (b) 12 Km/h
(c) 11 Km/h (d) 8 Km/h
(e) None of these

**[IBPS PO/MT, 2012]**

**100.** What was the speed of Vehicle C on Day 2 in terms of metres per second?

(a) 15.3 (b) 12.8
(c) 11.5 (d) 13.8
(e) None of these

**[IBPS PO/MT, 2012]**

**101.** The distance travelled by Vehicle F on Day 2 was approximately what percent of the distance travelled by it on Day 1?

(a) 80 (b) 65
(c) 85 (d) 95
(e) 90

**[IBPS PO/MT, 2012]**

**102.** What is the ratio of the speeds of Vehicle D and Vehicle E on Day 2?

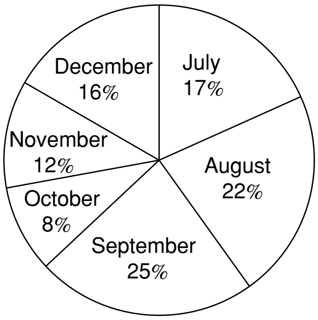
(a) 15:13 (b) 17:13
(c) 13:11 (d) 17:14
(e) None of these

**[IBPS PO/MT, 2012]**

**Directions (Question 103 to 107):** Study the following pie-chart and table carefully and answer the questions given below:

Percentage wise distribution of the number of mobile phones sold by a shopkeeper during six months

**Total number of mobile phones sold = 45000**




The ratio between the numbers of mobile phones sold of Company A and Company B during six months

**[IBPS PO/MT, 2012]**

| Month | Ratio |
|---|---|
| July | 8:7 |
| August | 4:5 |
| September | 3:2 |
| October | 7:5 |
| November | 7:8 |
| December | 7:9 |

**103.** What is the ratio of the number of mobile phones sold of Company B during July to those sold during December of the same company?

(a) 119:145 (b) 116:135
(c) 119:135 (d) 119:130
(e) None of these

**[IBPS PO/MT, 2012]**

**104.** If 35% of the mobile phones sold by Company A during November were sold at a discount, how many mobile phones of Company A during that month were sold without a discount?

(a) 882 (b) 1635
(c) 1638 (d) 885
(e) None of these

**[IBPS PO/MT, 2012]**

**105.** If the shopkeeper earned a profit of ₹433 one each mobile phone sold of Company B during October, what was his total profit earned on the mobile phones of that company during the same month?

(a) ₹6,49,900 (b) ₹6,45,900
(c) ₹6,49,400 (d) ₹6,49,500
(e) None of these

**[IBPS PO/MT, 2012]**

**106.** The number of mobile phones sold of Company A during July is approximately what per cent of the number of mobile phones sold of Company A during December?

(a) 110 (b) 140
(c) 150 (d) 105
(e) 130

**[IBPS PO/MT, 2012]**

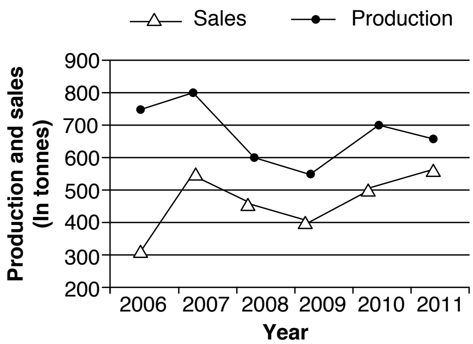
**107.** What is the total number of mobile phones sold of Company B during August and September together?

(a) 10000 (b) 15000
(c) 10500 (d) 9500
(e) None of these

**[IBPS PO/MT, 2012]**

**Directions (Question 108 to 112):** Study the following information and answer the questions that follow:

**The graph given below represents the production (in tonnes) and sales (in tonnes) of a company from 2006–2011.**




The table given below represents the ratio of the production (in tonnes) of Company A to the production (in tonnes) of Company B, and the ratio of the sales (in tonnes) of Company A to the sales (in tonnes) of Company B.

**[IBPS PO/MT, 2012]**

| Year | Production | Sales |
|---|---|---|
| 2006 | 5:4 | 2:3 |
| 2007 | 8:7 | 11:12 |
| 2008 | 3:4 | 9:14 |
| 2009 | 11:12 | 4:5 |
| 2010 | 14:13 | 10:9 |
| 2011 | 13:14 | 1:1 |

**108.** What is the approximate percentage increase in the production of Company A (in tonnes) from the year 2009 to the production of Company A (in tonnes) in the year 2010?

(a) 18% (b) 38%
(c) 23% (d) 27%
(e) 32%

**[IBPS PO/MT, 2012]**

**109.** The sales of Company A in the year 2009 was approximately what per cent of the production of Company A in the same year?

(a) 65% (b) 73%
(c) 79% (d) 83%
(e) 69%

**[IBPS PO/MT, 2012]**

**110.** What is the average production of Company B (in tonnes) from the year 2006 to the year 2011?

(a) 574 (b) 649
(c) 675 (d) 593
(e) 618

**[IBPS PO/MT, 2012]**

**111.** What is the ratio of the total production (in tonnes) of Company A to the total sales (in tonnes) of Company A?

(a) 81:64 (b) 64:55
(c) 71:81 (d) 71:55
(e) 81:55

**[IBPS PO/MT, 2012]**

**112.** What is the ratio of production of Company B (in tonnes) in the year 2006 to production of Company B (in tonnes) in the year 2008?

(a) 2:5 (b) 4:5
(c) 3:4 (d) 3:5
(e) 1:4

**[IBPS PO/MT, 2012]**

**Directions (Question 113 to 117):** Study the table carefully to answer the questions that follow:
The number of persons visiting six different Supermarkets and the percentage of Men, Women and Children visiting those Super markets

| Names of the Super markets | Total Number of Persons | Percentage of | | |
|---|---|---|---|---|
| | | Men | Women | Children |
| A | 34560 | 35 | 55 | 10 |
| B | 65900 | 37 | 43 | 20 |
| C | 45640 | 35 | 45 | 20 |
| D | 55500 | 41 | 26 | 33 |
| E | 42350 | 06 | 70 | 24 |
| F | 59650 | 24 | 62 | 14 |

**113.** The number of men visiting Super market D forms approximately what per cent of the total number of person visiting all the Super markets together?

(a) 11 (b) 5.5
(c) 13 (d) 9
(e) 7.5

**[IBPS PO/MT, 2011]**

**114.** The number of children visiting market C forms what per cent of the number of children visiting Supermarket F? (Rounded off two digits after decimal)

(a) 91.49 (b) 49.85
(c) 121.71 (d) 109.30
(e) None of these

**[IBPS PO/MT, 2011]**

**115.** What is the total number of children visiting Supermarket B and D together?

(a) 18515 (b) 28479
(c) 31495 (d) 22308
(e) None of these

**[IBPS PO/MT, 2011]**

**116.** What is the average of women visiting all the Supermarket together?

(a) 24823.5 (b) 22388.5
(c) 26432.5 (d) 20988.5
(e) None of these

**[IBPS PO/MT, 2011]**

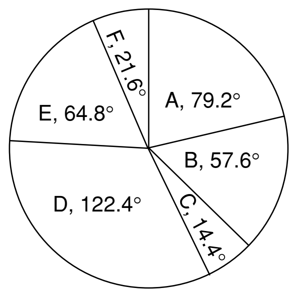
**117.** What is the ratio the number of women visiting Supermarket A to that of those visiting Supermarket C?

(a) 35:37 (b) 245:316
(c) 352:377 (d) 1041:1156
(e) None of these

**[IBPS PO/MT, 2011]**

**Directions (Question 118 to 122):** Study the following pie-chart and answer the questions given below:
Preferences of students of six beverages A, B, C, D, E and F in terms of degrees of angle in the pie-chart

Total No. of students = 6800




**118.** What is the difference between the total number of students who prefer beverage A and C together and the total number of students who prefer beverage D and F together?

(a) 959 (b) 955
(c) 952 (d) 954
(e) None of these

**[IBPS PO/MT, 2011]**

**119.** What is the ratio of the number of students who prefer beverage F to the number of students who prefer beverage A?

(a) 3:11 (b) 3:13
(c) 6:11 (d) 5:11
(e) None of these

**[IBPS PO/MT, 2011]**

**120.** The number of students who prefer beverage E and F together is what percent of the total number of students?

(a) 18 (b) 14
(c) 26 (d) 24
(e) None of these

**[IBPS PO/MT, 2011]**

**121.** The number of students who prefer beverage C is approximately what per cent of the number of students who prefer beverage D?

(a) 7 (b) 12
(c) 18 (d) 22
(e) 29

**[IBPS PO/MT, 2011]**

**122.** How many students prefer beverage B and Beverage E together?

(a) 2312 (b) 2313
(c) 2315 (d) 2318
(e) None of these

**[IBPS PO/MT, 2011]**

**Directions (Question 123 to 127):** Study the table carefully to answer the questions that follow:

Percentage of Marks Obtained by Different Students in Different Subject of MBA

| | SUBJECTS (Maximum Marks) | | | | | |
|---|---|---|---|---|---|---|
| **Students** | **Strategic Management (150)** | **Brand Management (100)** | **Compensation Management (150)** | **Consumer Behaviour (125)** | **Service Markeing (75)** | **Training & Development (50)** |
| Anushka | 66 | 75 | 88 | 56 | 56 | 90 |
| Archit | 82 | 76 | 84 | 96 | 92 | 88 |
| Arpan | 76 | 66 | 78 | 88 | 72 | 70 |
| Garvita | 90 | 88 | 96 | 76 | 84 | 86 |
| Gunit | 64 | 70 | 68 | 72 | 68 | 74 |
| Pranita | 48 | 56 | 50 | 64 | 64 | 58 |

**123.** How many marks did Anushka get in all the subject together?

(a) 369 (b) 463
(c) 558 (d) 496
(e) None of these

**[IBPS PO/MT, 2011]**

**124.** The marks obtained by Garvita in Brand Management is what per cent of the marks obtained by Archit in the same subject? (Rounded off to two digits after decimal)

(a) 86.36 (b) 101.71
(c) 115.79 (d) 133.33
(e) None of these

**[IBPS PO/MT, 2011]**

**125.** What is the average marks obtained by all students together in compensation Management?

(a) 116 (b) 120
(c) 123 (d) 131
(e) None of these

**[IBPS PO/MT, 2011]**

**126.** Who has scored the highest total marks in all the subjects together?

(a) Archit (b) Gunit
(c) Pranita (d) Garvita
(e) Arpan

**[IBPS PO/MT, 2011]**

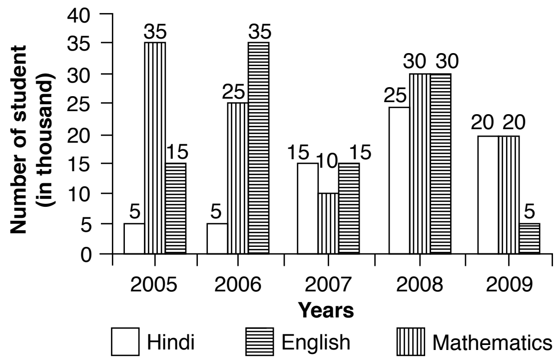
**127.** How many students have scored the highest marks in more than one subject?

(a) three (b) two
(c) one (d) none
(e) None of these

**[IBPS PO/MT, 2011]**

**Directions (Question 128 to 132):** Study the following graph and answer the questions that follow:

No. of students (in thousand) who opted for three different specializations during the given five years in a university




**128.** Out of the total number of students who opted for the given three subjects, in the year 2009, 38% were girls. How many boys opted for Mathematics in the same year?

(a) 1322 (b) 1332
(c) 1312 (d) Cannot be determined
(e) None of these

**[IBPS PO/MT, 2011]**

**129.** If the total number of student in the university in the year 2007 was 455030, the total number of students who opted for the given three subjects was approximately what per cent of the total students?

(a) 19 (b) 9
(c) 12 (d) 5
(e) 23

**[IBPS PO/MT, 2011]**

**130.** What is the total number of students who opted for Hindi and Mathematics in the years 2006, 2007 and 2009 together?

(a) 97000 (b) 93000
(c) 85000 (d) 96000
(e) None of these

**[IBPS PO/MT, 2011]**

**131.** The total number of students who opted for Mathematics in the years 2005 and 2008 together is approximately what per cent of the total number of students who opted for all three subjects in the same years?

(a) 38
(b) 28
(c) 42
(d) 32
(e) 48

**[IBPS PO/MT, 2011]**

**132.** What is the ratio of the number of students who opted for English in the years 2006 and 2008 together to the number of students who opted for Hindi in the year 2005 and 2009 together?

(a) 11:5 (b) 12:7
(c) 11:7 (d) 12:5
(e) None of these

**[IBPS PO/MT, 2011]**

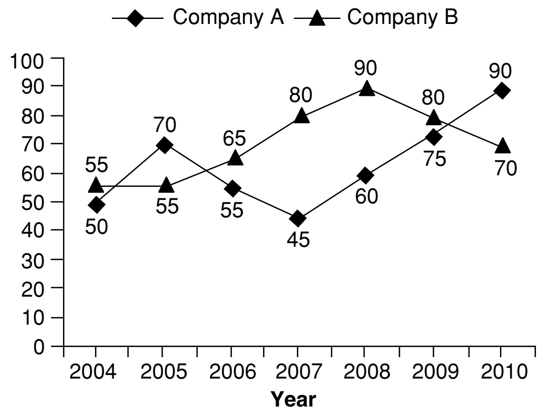
**Directions (Question 133 to 140):** Study the following graph carefully to answer these question.

Per cent profit earned by two companies producing electronic goods over the years

$$\% \text{ Profit} = \frac{\text{Profit Earned}}{\text{Total Investment}} \times 100$$

**[SBI Associates Banks PO/MT, 2011]**

Profit Earned = Total Income – Total Investment in the year




**133.** If the profit earned in 2006 by Company B was ₹8,12,500, what was the total income of the company in that year?

(a) ₹12,50,000
(b) ₹20,62,500
(c) ₹16,50,000
(d) ₹18,25,000
(e) None of these

**[SBI Associates Banks PO, 2011]**

**134.** If the amount invested by the two companies in 2005 was equal, what was the ratio of the total income of the Company A to that of B in 2055?

(a) 31:33 (b)33:31
(c) 34:31 (d) 14:11
(e) None of these

**[SBI Associates Banks PO, 2011]**

**135.** If the total amount invested by the two companies in 2009 was ₹27 Lakhs, while the amount invested by company B was 50% of the amount invested by Company A, what was the total profit earned by the two Companies together?

(a) ₹21.15 Lakhs (b) ₹20.70 Lakhs
(c) ₹18.70 Lakhs (d) ₹20.15 Lakhs
(e) None of these

**[SBI Associates Banks PO, 2011]**

**136.** If the income of Company A in 2007 and that in 2008 were equal and the amount invested in 2007 was ₹12 Lakhs, what was the amount invested in 2008?

(a) ₹10,87,500 (b) ₹10,85,700
(c) ₹12,45,000 (d) ₹12,85,000
(e) None of these

**[SBI Associates Banks PO, 2011]**

**137.** If the amount of profit earned by Company A in 2006 was ₹10.15 Lakhs, what was the total investment?

(a) ₹13.8 Lakhs (b) ₹14.9 Lakhs
(c) ₹15.4 Lakhs (d) ₹14.2 Lakhs
(e) None of these

**[SBI Associates Banks PO, 2011]**

**138.** If the amount invested by Company B in 2004 is ₹12 Lakhs and the income of 2004 is equal to the investment in 2005, what is the amount of profit earned in 2005 by Company B?

(a) ₹6.6 Lakhs
(b) ₹18.6 Lakhs
(c) ₹10.23 Lakhs
(d) ₹9.6 Lakhs
(e) None of these

**[SBI Associates Banks PO, 2011]**

**139.** If the investments of Company A in 2007 and 2008 were equal, what is the difference between the profits earned in the two years if the income in 2008 was ₹24 Lakhs?

(a) ₹2.25 Lakhs (b) ₹3.6 Lakhs
(c) ₹1.8 Lakhs (d) ₹2.6 Lakhs
(e) None of these

**[SBI Associates Banks PO, 2011]**

**140.** If each of the companies A and B invested ₹25 Lakhs in 2010, what was the average profit earned by the two companies?

(a) ₹18 Lakhs (b) ₹22.5 Lakhs
(c) ₹17.5 Lakhs (d) ₹20 Lakhs
(e) None of these

**[SBI Associates Banks PO, 2011]**

**Directions (Question 141 to 147):** Study the following table carefully and answer the questions which follow. Number of Candidates found Eligible and the Number of Candidates Short listed for Interview for a recent Recruitment Process for Six Posts form different states

| **Post** | **I** | | **II** | | **III** | | **IV** | | **V** | | **VI** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **State** | **E** | **S** | **E** | **S** | **E** | **S** | **E** | **S** | **E** | **S** | **E** | **S** |
| A | 2500 | 65 | 7200 | 240 | 5200 | 76 | 3600 | 200 | 4600 | 110 | 5400 | 380 |
| B | 3200 | 220 | 8500 | 420 | 8400 | 190 | 6200 | 320 | 5800 | 180 | 6200 | 430 |
| C | 2800 | 280 | 4500 | 350 | 7600 | 160 | 8200 | 440 | 7300 | 310 | 3700 | 250 |
| D | 2400 | 85 | 4800 | 200 | 2600 | 55 | 7500 | 350 | 3900 | 160 | 4800 | 360 |
| E | 3000 | 120 | 5600 | 280 | 3800 | 75 | 6800 | 280 | 6100 | 260 | 7800 | 520 |
| F | 4800 | 325 | 6400 | 320 | 4400 | 220 | 4700 | 180 | 4900 | 220 | 8800 | 640 |
| G | 6500 | 550 | 7000 | 140 | 6000 | 325 | 5500 | 220 | 8100 | 410 | 2700 | 200 |

E-Eligible **S**-Short listed

**141.** From State B, which post had the highest percentage of candidates short listed?

(a) V (b) IV
(c) VI (d) II
(e) None of these

**[SBI Associates Banks PO, 2011]**

**142.** What is the average number of candidates (approximately) found eligible for Past III form all states?

(a) 6700
(b) 6200
(c) 4200
(d) 4500
(e) 5500

**[SBI Associates Banks PO, 2011]**

**143.** What is the overall percentage (rounded off to one digit after decimal) of candidates short listed over the total number of candidates eligible for Post I form all the States together?

(a) 9.5% (b) 12.5%
(c) 7.2% (d) 6.52%
(e) None of these

**[SBI Associates Banks PO, 2011]**

**144.** What is the ratio of the total number of candidates shortlisted for all the posts together from State E to that from stateG?

(a) 307:369 (b) 73:79
(c) 6:5 (d) 9:7
(e) None of these

**[SBI Associates Banks PO, 2011]**

**145.** The total number of candidates found eligible for Post I from all states together is approximately what percent of total number of candidates found eligible for Post VI from all States together?

(a) 45% (b) 50%
(c) 60% (d) 55%
(e) 63.9%

**[SBI Associates Banks PO, 2011]**

**146.** Which state had the lowest percentage of candidates short listed with respect to candidate eligible for Post IV?

(a) G (b) F
(c) E (d) C
(e) None of these

**[SBI Associates Banks PO, 2011]**

**147.** What is the ratio of the total number of candidates short listed for post V to that for post VI from all states together?

(a) 6:7 (b) 55:96
(c) 165:278 (d) 16:25
(e) None of these

**[SBI Associates Banks PO, 2011]**

**Directions (Question 148 to 152):** These questions are based on following date. Study it carefully and answer the questions that follow.

In a school having 400 students, boys and girls are in the ratio of 3:5. The students speak Hindi, English or both the languages. 12% of the boys speak only Hindi. 22% of the girls speakonly English. 24% of the total students speak only Hindi and the number of boys speaking both the languages is six times the number of boys speaking only Hindi.

**148.** How many boys speak Hindi?

(a) 18 (b) 126
(c) 108 (d) 26
(e) None of these

**[SBI Associates Banks PO, 2011]**

**149.** How many girls speak only Hindi?

(a) 55 (b) 117
(c) 96 (d) 78
(e) None of these

**[SBI Associates Banks PO, 2011]**

**150.** How many students speak English?

(a) 304 (b) 79
(c) 225 (d) 117
(e) None of these

**[SBI Associates Banks PO, 2011]**

**151.** The number of girls speaking only Hindi is what per cent of the total number of students speaking only Hindi?

(a) 38.2% (b) 71.8%
(c) 31.2% (d) 78%
(e) None of these

**[SBI Associates Banks PO, 2011]**

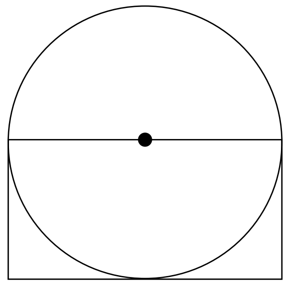
**152.** What is the ratio of the number of boys to the number of girls speaking both the languages?

(a) 23:25 (b) 12:25
(c) 12:13 (d) 25:13
(e) None of these

**[SBI Associates Banks PO, 2011]**

**Directions (Question 153 to 156):** Study the information given in eachof thesequestions and then answer the questions.

**153.** The area of the circle is 616 $cm^2$. What is the area of the rectangle?



(a) 784 $cm^2$ (b) 196 $cm^2$
(c) 392 $cm^2$ (d) Cannot be determined
(e) None of these

**[SBI Associates Banks PO, 2011]**

**154. Population in Million**

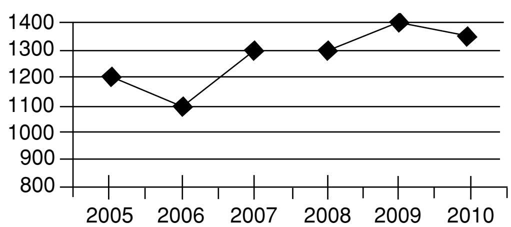
| City | Total Population | Male Population |
|---|---|---|
| A | 12 | 6.5 |
| B | 15 | 7.2 |
| C | 17 | 9.0 |
| D | 19 | 9.9 |
| E | 22 | 10.8 |

What is the average female population in million?

(a) 8.32
(b) 8.86
(c) 8.68
(d) 9.12
(e) None of these

**[SBI Associates Banks PO, 2011]**

**155.** What is the per cent rise in production in 2007 from 2006? (Round off to two digits after decimal.)

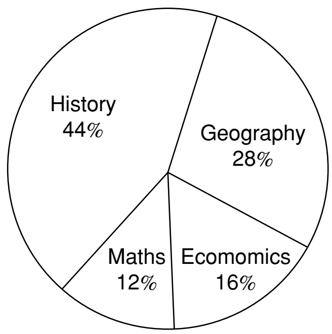


(a) 28.18%
(b) 18.18%
(c) 16.28%
(d) 26.18%
(e) None of these

**[SBI Associates Banks PO, 2011]**

**156.** Out of a total 550 students, how many students did not prefer Maths or Economics?

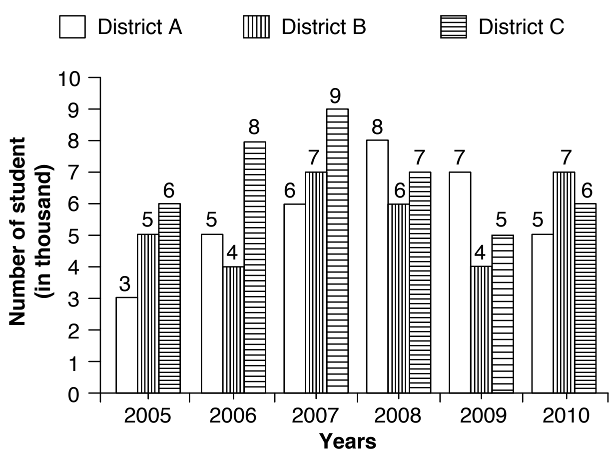
**Break-up of students having preference for each subject**




(a) 462
(b) 154
(c) 196
(d) 396
(e) None of these

**[SBI Associates Banks PO, 2011]**

**Directions (Question 157 to 161):** Study the following graph carefully to answer the questions that follow:
Number of students (in thousand) enrolled in three different districts in six different years




**157.** What was the percentage increase in enrolment in the number of students in District C in year 2007 as compared to that in the previous year?

(a) 115.5
(b) 112.5
(c) 15.5
(d) 12.5
(e) None of these

**[IOB PO, 2011]**

**158.** What was the difference between the number of students enrolled in all the three districts together in the year 2008 and the number of students enrolled in District Bover all the years together?

(a) 12000
(b) 11000
(c) 1100
(d) 1400
(e) None of these

**[IOB PO, 2011]**

**159.** What was the approximate average number of students enrolled in District A over all the years together?

(a) 5999
(b) 5666
(c) 5444
(d) 5333
(e) None of these

**[IOB PO, 2011]**

**160.** In which year was the number of students enrolled in all the three districts together the second highest?

(a) 2006
(b) 2007
(c) 2008
(d) 2009
(e) 2010

**[IOB PO, 2011]**

**161.** Total number of students enrolled in District A and District B together in the year 2010 was what percentage of the total number of students enrolled in District A in the year 2008?

(a) 150
(b) 120
(c) 250
(d) 220
(e) None of these

**[IOB PO, 2011]**

**Directions (Question 162 to 166):** Study the table carefully to answer the questions that follow:
Number of candidates appeared and qualified for a test (in hundred) in six different years from five different zones.

| | *Zone* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Year* | *P* | | *Q* | | *R* | | *S* | | *T* | |
| | *App.* | *Qual.* | *App.* | *Qual.* | *App.* | *Qual.* | *App.* | *Qual.* | *App.* | *Qual.* |
| 2005 | 3.2 | 2.5 | 3.5 | 1.4 | 3.8 | 2.2 | 4.2 | 2.4 | 6.2 | 2.6 |
| 2006 | 4.6 | 3.4 | 6.9 | 4.2 | 6.9 | 4.4 | 7.4 | 3.3 | 6.2 | 4.8 |
| 2007 | 6.5 | 4.9 | 7.7 | 4.5 | 5.9 | 4.8 | 8.3 | 5.6 | 6.4 | 4.2 |
| 2008 | 7.4 | 5.7 | 5.4 | 3.4 | 7.2 | 3.2 | 9.3 | 6.4 | 7.8 | 6.2 |
| 2009 | 8.8 | 4.8 | 6.6 | 5.2 | 8.6 | 6.8 | 11.4 | 5.2 | 9.9 | 6.9 |
| 2010 | 9.2 | 5.6 | 10.6 | 6.4 | 10.3 | 7.4 | 14.2 | 11.4 | 11.8 | 9.4 |

*App. — Appeared; Qual. — Qualified*

**162.** In which year was in Zone S the difference between the appeared candidates and qualified candidates the second lowest?

(a) 2005 (b) 2007
(c) 2008 (d) 2009
(e) 2010

**[IOB PO, 2011]**

**163.** The number of candidates who qualified the test from Zone R in the year 2010 was approximately what percentage of the number of candidates who appeared from Zone Q in the year 2008?

(a) 152 (b) 147
(c) 142 (d) 132
(e) 137

**[IOB PO, 2011]**

**164.** What was the average number of candidates appeared from Zone T over all the years together?

(a) 810
(b) 815
(c) 825
(d) 805
(e) 820

**[IOB PO, 2011]**

**165.** What was the ratio of the number of candidates appeared from Zone P in the year 2005 to the number of candidates qualified from Zone S in the year 2007?

(a) 4:7 (b) 4:9
(c) 9:4 (d) 8:13
(e) None of these

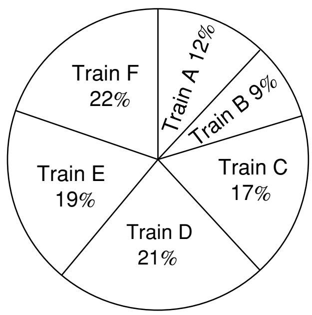
**[IOB PO, 2011]**

**166.** From which zone was the total number of candidates who qualified the test, the second highest in the year 2009 and 2010 together?

(a) P (b) Q
(c) R (d) S
(e) T

**[IOB PO, 2011]**

**Directions (Question 167 to 171):** Study the following pie-chart carefully to answer these questions:
Total number of passengers in six different trains = 4800
Percentage-wise distribution of passengers




**167.** What was the average number of passengers travelling in Train A, Train C and Train F together?

(a) 816 (b) 826
(c) 824 (d) 812
(e) None of these

**[IOB PO, 2011]**

**168.** If the cost of one ticket is ₹124, what is the total amount paid by passengers of Train B? (Assuming all the passengers purchased tickets and cost of each ticket is equal)

(a) ₹53,658 (b) ₹53,568
(c) ₹53,558 (d) ₹53,468
(e) None of these

**[IOB PO, 2011]**

**169.** The number of passengers in Train E is approximately what percentage of the total number of passengers in Train B and Train D together?

(a) 63 (b) 69
(c) 75 (d) 54
(e) 79

**[IOB PO, 2011]**

**170.** What is the difference between the number of passengers Train C and the number of passengers in Train A?

(a) 280 (b) 250
(c) 230 (d) 260
(e) None of these

**[IOB PO, 2011]**

**171.** What is the total number of passengers in Train D, Train E and Train F together?

(a) 2796 (b) 3225
(c) 2976 (d) 3125
(e) None of these

**[IOB PO, 2011]**

**Directions (Question 172 to 176):** Study the following table carefully to answer the questions that follow.

Semester fees (in ₹ thousand) for five different courses in six different years

| | | | *Course* | | |
|---|---|---|---|---|---|
| *Years* | *B Tech* | *M Sc* | *B Ed* | *M Phil* | *Diploma* |
| 2005 | 11.5 | 5.8 | 7.5 | 4.7 | 1.8 |
| 2006 | 14.5 | 6.4 | 11.6 | 5.8 | 3.2 |
| 2007 | 20.0 | 10.2 | 13.9 | 8.6 | 4.8 |
| 2008 | 22.2 | 14.6 | 15.8 | 12.7 | 5.6 |
| 2009 | 35.8 | 17.7 | 18.5 | 25.1 | 12.5 |
| 2010 | 50.7 | 20.9 | 22.6 | 18.9 | 14.9 |

**172.** What was the approximate per cent increase in the semester fees of BEd course in the year 2007 as compared to the previous year?

(a) 26 (b) 30
(c) 20 (d) 16
(e) 10

**[IO PO, 2011]**

**173.** What was the average semester fee charged for MSc course over all the years together?

(a) ₹12,700 (b) ₹12,600
(c) ₹12,060 (d) ₹12070
(e) ₹13,140

**[IOB PO, 2011]**

**174.** What was the difference between the total semester fee charged for Diploma course over all the years together and the fee charged for BTech course in the year 2009?

(a) ₹8,500 (b) ₹8,000
(c) ₹6,500 (d) ₹7,000
(e) None of these

**[IOB PO, 2011]**

**175.** The semester fee charged for M Phil course in the year 2008 was approximately what percentage of the semester fee charged for MSc course in the year 2009?

(a) 67 (b) 84
(c) 80 (d) 76
(e) 72

**[IOB PO, 2011]**

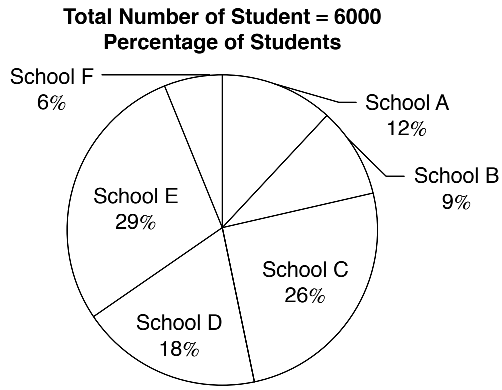
**176.** What was the total semester fee charged for all the courses together in the year 2006?

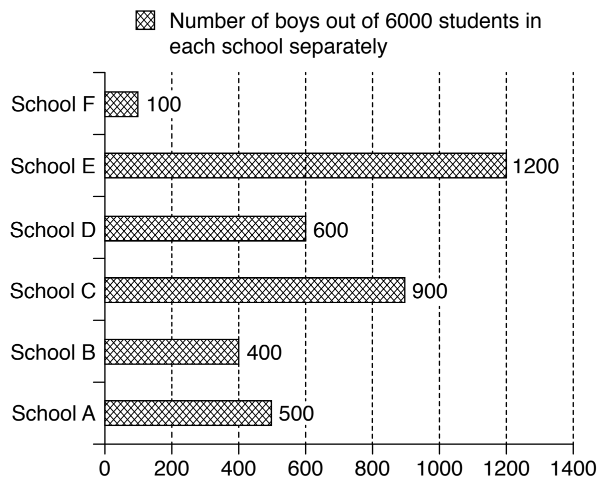
(a) ₹42,500 (b) ₹41,500
(c) ₹41,600 (d) ₹42,200
(e)None of these

**[IOB PO, 2011]**

**Directions (Question 177 to 181):** Study the following pie-chart and bar diagram and answer the following questions. Percentage-wise distribution of Students in six different Schools

**Total number of Students = 6000 Percentage of students**



**177.** What is the sum of the number of girls in School C, the number of girls in School E and the number of boys in School D together?

(a) 1700 (b) 1900
(c) 1600 (d) 1800
(e) None of these

**[Allahabad Bank PO, 2011]**

**178.** What is the ratio of the number of boys in School C, the number of girls in School B and the total number of students in School E?

(a) 45:7:97 (b) 43:9:97
(c) 45:7:87 (d) 43:9:87
(e) None of these

**[Allahabad Bank PO, 2011]**

**179.** What is the difference between the total number of students in School F and the number of boys in School E?

(a) 820 (b) 860
(c) 880 (d) 900
(e) None of these

**[Allahabad Bank PO, 2011]**

**180.** In which of the following schools is the total number of students equal to the number of girls in School E?

(a) A (b) B
(c) C (d) D
(e) F

**[Allahabad Bank PO, 2011]**

**181.** The number of girls in School A is approximately what percentage of the total number of students in School B?

(a) 55 (b) 50
(c) 35 (d) 45
(e) 41

**[Allahabad Bank PO, 2011]**

**Directions (Question 182 to 186):** Study the following table carefully and answer the questions given below:

Number of Tickets sold in a week of five movies in multiplexes in six different cities (Number in thousands)

| Movie / City | A | B | C | D | E |
|---|---|---|---|---|---|
| Mumbai | 20 | 15 | 35 | 26 | 18 |
| Delhi | 17 | 19 | 21 | 25 | 28 |
| Kolkata | 32 | 24 | 19 | 21 | 17 |
| Chennai | 18 | 21 | 32 | 28 | 34 |
| Hyderabad | 16 | 34 | 26 | 29 | 22 |
| Lucknow | 15 | 27 | 20 | 35 | 26 |

**182.** The number of tickets of Movie B sold in Hyderabad was approximately what percentage of the total numberof tickets of the same movie sold in all the cities together?

(a) 15 (b) 18
(c) 12 (d) 20
(e) 24

**[Allahabad Bank PO, 2010]**

**183.** What is the difference between the number of tickets of Movie D sold in Kolkata and the number of tickets of: Movie B sold in Lucknow?

(a) 700 (b) 7,000
(c) 14,000 (d) 9,000
(e) None of these

**[Allahabad Bank PO, 2010]**

**184.** What is the average number of tickets of Movie C soldin all the six cities?

(a) 15,500 (b) 2,550
(c) 24,000 (d) 25,500
(e) None of these

**[Allahabad Bank PO, 2010]**

**185.** The number of tickets of Movie E sold in Chennai is what percentage of the number of tickets of Movie A sold in Mumbai?

(a) 170 (b) 70
(c) 30 (d) 130
(e) None of these

**[Allahabad Bank PO, 2010]**

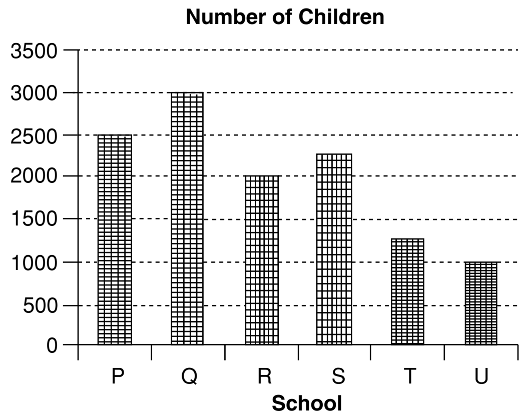
**186.** In which city was the total number of tickets of all the five movies together sold the minimum?

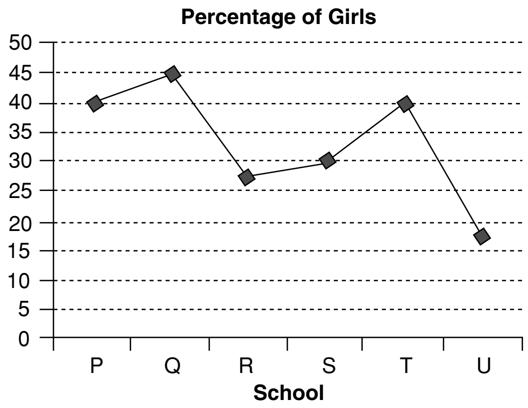
(a) Delhi (b) Chennai
(c) Lucknow (d) Kolkata
(e) None of these

**[Allahabad Bank PO, 2010]**

**Directions (Question 187 to 191):** Study the graphs carefully to answer the questions that follow:

Total number of children in 6 different schools and the percentage of girls in them






**187.** What is the total percentage of boys in schools R and U together? (Rounded off to two digits after decimal)

(a) 78.55
(b) 72.45
(c) 76.28
(d) 75.83
(e) None of these

**[SBI Associate Banks PO, 2010]**

**188.** What is the total number of boys in School T?

(a) 500 (b) 600
(c) 750 (d) 850
(e) None of these

**[SBI Associate Banks PO, 2010]**

**189.** The total number of students in school R is approximately what per cent of the total number of students in school S?

(a) 89 (b) 75
(c) 78 (d) 82
(e) 94

**[SBI Associate Banks PO, 2010]**

**190.** What is the average number of boys in schools P and Q together?

(a) 1425 (b) 1575
(c) 1450 (d) 1625
(e) None of these

**[SBI Associate Banks PO, 2010]**

**191.** What is the ratio of the number of girls in school P to the number of girls in school Q?

(a) 27:20 (b) 17:21
(c) 20:27 (d) 21:17
(e) None of these

**[SBI Associate Banks PO, 2010]**

**Directions (Question 192 to 193):** Study the table carefully to answer the questions that follow.
Percentage of marks obtained by six students in six different subjects

| Subject→ Student↓ | Hindi (Out of 175) | English (Out of 80) | Science (Out of 125) | Mathematics (Out of 100) | Social Studies (Out of 120) | Sanskrit (Out of 35) |
|---|---|---|---|---|---|---|
| A | 87 | 84 | 91 | 66 | 39 | 84 |
| B | 58 | 68 | 87 | 74 | 57 | 79 |
| C | 63 | 71 | 81 | 94 | 44 | 86 |
| D | 48 | 57 | 70 | 79 | 68 | 44 |
| E | 83 | 83 | 49 | 77 | 55 | 50 |
| F | 74 | 68 | 42 | 63 | 61 | 58 |

**192.** What is the average marks obtained by student F in Hindi, English and Science subjects together?

(a) 78
(b) 82.4
(c) 78.8
(d) 84
(e) None of these

**[Indian Bank PO, 2010]**

**193.** What is the average marks obtained by all the students in Science?

(a) 87 (b) 86.5
(c) 90 (d) 87.5
(e) None of these

**[Indian Bank PO, 2010]**

**Directions (Question 194 to 198):** Study the following table carefully to answer the questions that follow:

Production of Sugar (in tonnes) of three different States over the years

| Year→ State↓ | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|
| P | 4.3 | 4.9 | 5.6 | 5.8 | 6.7 | 7.4 |
| Q | 3.1 | 3.7 | 4.4 | 5.1 | 6.0 | 6.2 |
| R | 3.9 | 4.7 | 5.8 | 6.6 | 7.3 | 8.3 |

**194.** What is the approximate percentage increase in production of sugar in state Q from 2006 to 2007?

(a) 12 (b) 18
(c) 24 (d) 10
(e) 21

**[Indian Bank PO, 2010]**

**195.** What is the average production of sugar of all the three states in 2003 and 2004 together?

(a) 4.1 tonnes (b) 4.7 tonnes
(c) 5.1 tonnes (d) 4.8 tonnes
(e) None of these

**[Indian Bank PO, 2010]**

**196.** What is the ratio of the total production of sugar of all three states in the year 2006 to that in 2007?

(a) 7:9 (b) 6:7
(c) 8:7 (d) 7:8
(e) 11:12

**[Indian Bank PO, 2010]**

**197.** What is the average production of sugar of state R for all the years together?

(a) 24 tonnes (b) 6.3 tonnes
(c) 7.1 tonnes (d) 6.1 tonnes
(d) None of these

**[Indian Bank PO, 2010]**

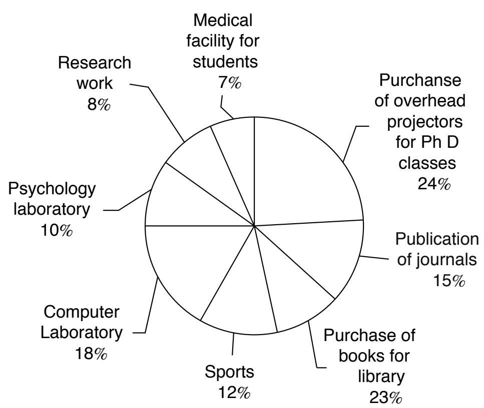
**198.** What is the difference between the total production of sugar of all the three states together in 2008 and that in 2005?

(a) 9 tonnes (b) 4.3 tonnes
(c) 6.1 tonnes (d) 5.1 tonnes
(e) None of these

**[Indian Bank PO, 2010]**

**Directions (Question 199 to 203):** Study the following pie-chart to answer these questions.

**TOTAL EXPENDITURE: ₹60 Lakhs**




**199.** What is the ratio of the expenditure made by the university on Research work and that on purchase of books for library?

(a) 4:5
(b) 5:4
(c) 8:3
(d) 8:5
(e) None of these

**[Indian Bank PO, 2010]**

**200.** What is the total sum of expenditure on Research work, Purchase of overhead projectors for PhD classes and Purchase of books for library together?

(a) ₹22.6 Lakhs (b) ₹22.8 Lakhs
(c) ₹23.4 Lakhs (d) ₹20.8 Lakhs
(e) None of these

**[Indian Bank PO, 2010]**

**201.** What is the difference between the expenditure made by the university for Publication of journals and for Psychology laboratory?

(a) ₹4 Lakhs
(b) ₹3 Lakhs
(c) ₹4.2 Lakhs
(d) ₹3. 8 Lakhs
(e) None of these

**[Indian Bank PO, 2010]**

**202.** If the expenditure on the Purchase of overhead projectors for PhD students is decreased by 7%, what will be the expenditure on the same after the decrease?

(a) ₹1,33,920
(b) ₹13,39,200
(c) ₹1,02,000
(d) ₹1,08,000
(e) None of these

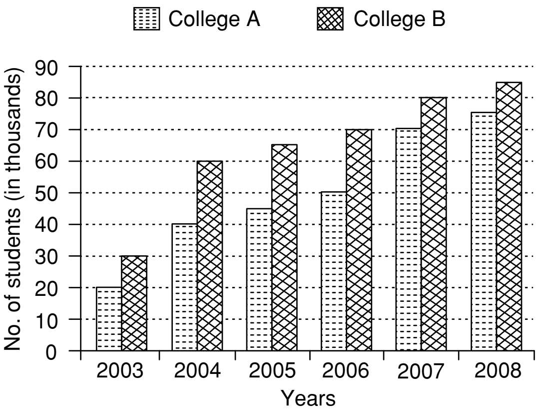
**[Indian Bank PO, 2010]**

**203.** Which of the following is definitely true?

(a) The ratio of expenditure of university for the purchase of library books and expenditure on computer laboratory is 3:1 respectively.
(b) Expenditure on medical facilities for students is ₹4.6 Lakhs
(c) The difference between the expenditure on research work and that on medical facility for student is ₹60,000.
(d) All are true
(e) None of these

**[Indian Bank PO, 2010]**

**Directions (Question 204 to 208):** Study the following graph carefully to answer these questions.
No. of students in College A and College B over the years




**204.** For which college(s) and in which year was the per cent rise in number of students from the previous year the highest?

(a) College A in year 2004 and College B in year 2005
(b) Only College B in year 2004
(c) College A in year 2004 and College B in year 2004
(d) College A in year 2007 and College B in year 2004
(e) None of these

**[Indian Bank PO, 2010]**

**205.** What is the ratio of the total number of students of College A in years 2004, 2006 and 2007 together and the total number of students of College B in years 2003, 2004 and 2008?

(a) 35:32 (b) 33.37
(c) 34:31 (d) 32:35
(e) None of these

**[Indian Bank PO, 2010]**

**206.** What is the average number of students in College A for all the years together?

(a) 45,000 (b) 50,000
(c) 52,000 (d) 48,000
(e) None of these

**[Indian Bank PO, 2010]**

**207.** What is the approximate percentage rise in the number of students of College B from 2005 to 2006?

(a) 8 (b) 12
(c) 4 (d) 15
(e) 20

**[Indian Bank PO, 2010]**

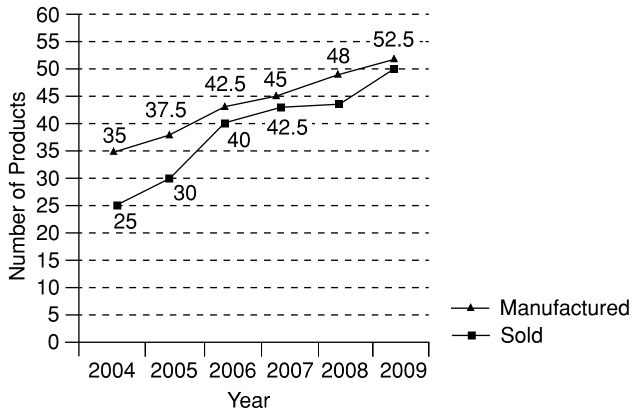
**208.** The number of students of College B in year 2008 is what per cent of the total students of College B in all the years together? (Round off to two digits after decimal)

(a) 20.61 (b) 23.79
(c) 21.79 (d) 17.29
(e) None of these

**[Indian Bank PO, 2010]**

**Directions (Question 209 to 213):** Study the following graph carefully to answer the questions:

Number (in thousands) of products manufactured and sold by a company over the years




**209.** What is the difference between the number of products manufactured by the company in the year 2009 and that in 2008?

(a) 4000 (b) 5500
(c) 3500 (d) 4500
(e) None of these

**[IDBI Bank PO, 2009]**

**210.** The number of products sold by the company in the year 2004 is what per cent of the number of products manufactured by it in that year? (Rounded off to two digits after decimal)

(a) 71.43 (b) 67.51
(c) 81.67 (d) 56.29
(e) None of these

**[IDBI Bank PO, 2009]**

**211.** What is the per cent increase in the number of products sold by the company in the year 2006 from the previous year? (Rounded off to two digits after decimal)

(a) 19.25 (b) 33.33
(c) 10.45 (d) 42.66
(e) None of these

**[IDBI Bank PO, 2009]**

**212.** What is the ratio of the number of products not sold by the company in the year 2007 to that not sold in the year 2005?

(a) 3:1 (b) 6:5
(c) 1:3 (d) 5:6
(e) None of these

**[IDBI Bank PO, 2009]**

**213.** What is the approximate average number of products manufactured by the company over all the years together?

(a) 36550 (b) 39480
(c) 41220 (d) 43330
(e) 34420

**[IDBI Bank PO, 2009]**

**Directions (Question 214 to 218):** Study the following information carefully and answer the questions that follow:

An office consists of 520 employees working in different departments, viz. HR, IT, Production and Marketing. The ratio of men to women in the organisation is 5:3.20 per cent of the men work in the IT department. 40 per cent of the women work in the HR department. The total number of employees in the Production department is 135. Two-fifths of the women work in the IT department and the remaining work in the Marketing department. 40 per cent of the men work in the Production department. Four per cent of the men work in the HR department and the remaining work in the Marketing department.

**214.** The number of men working in the Marketing department forms what per cent of the total number of employees in the organisation?

(a) 22.5 (b) 34.5
(c) 19.5 (d) 38.5
(e) None of these

**[IDBI Bank PO, 2009]**

**215.** What is the ratio of the number of men working in the HR department to that of the women working in the same?

(a) 1:5 (b) 2:3
(c) 4:7 (d) 9:11
(e) None of these

**[IDBI Bank PO, 2009]**

**216.** What is the number of women working in the Marketing department?

(a) 41 (b) 34
(c) 46 (d) 39
(e) None of these

**[IDBI Bank PO, 2009]**

**217.** Total number of employees working in the Production department forms approximately what per cent of the total number of employees working in the organisation?

(a) 12 (b) 17
(c) 21 (d) 26
(e) 38

**[IDBI Bank PO, 2009]**

**218.** What is the total number of employees working in the IT department?

(a) 130 (b) 124
(c) 143 (d) 101
(e) None of these

**[IDBI Bank PO, 2009]**

**Directions (Question 219 to 223):** Study the following table carefully to answer the questions that follow:

Number of Executives recruited by six different organisations over the years

| Organisation→ Year↓ | P | Q | R | S | T | U |
|---|---|---|---|---|---|---|
| 2004 | 458 | 512 | 418 | 502 | 476 | 492 |
| 2005 | 522 | 536 | 472 | 500 | 482 | 523 |
| 2006 | 480 | 495 | 464 | 508 | 488 | 518 |
| 2007 | 506 | 505 | 428 | 444 | 490 | 534 |
| 2008 | 427 | 485 | 422 | 512 | 510 | 498 |
| 2009 | 492 | 488 | 444 | 499 | 512 | 510 |

**219.** What is the total number of Executives recruited by all the organisations together in the year 2006?

(a) 2927 (b) 3042
(c) 2864 (d) 3143
(e) None of these

**[IDBI Bank PO, 2009]**

**220.** What is the ratio of the total number of Executives recruited by organisation U in the years 2007 and 2009 together to the total number of Executives recruited by organisation P in the same years?

(a) 436:517 (b) 499:522
(c) 51.7:436 (d) 522:499
(e) None of these

**[IDBI Bank PO, 2009]**

**221.** What is the average number of Executives recruited by organisation S over all the years together? (Rounded off the nearest integer)

(a) 494 (b) 482
(c) 514 (d) 506
(e) 478

**[IDBI Bank PO, 2009]**

**222.** What is the per cent increase in the number of Executives recruited by organisation R in 2005 from the previous year? (Rounded off to two digits after decimal)

(a) 18.67 (b) 12.92
(c) 16.48 (d) 13.21
(e) None of these

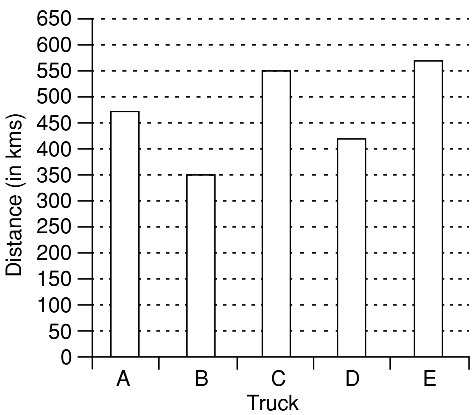
**[IDBI Bank PO, 2009]**

**223.** The number of Executives recruited by organisation T in the year 2008 forms approximately what per cent of the total number of Executives recruited by all the organisations together in that year?

(a) 11 (b) 31
(c) 18 (d) 26
(e) 23

**[IDBI Bank PO, 2009]**

**Directions (Question 224 to 228):** Study the following graph carefully to answer the questions that follow:
Distance (in Km) travelled by five different trucks in a day




**224.** What is the ratio of the distance travelled by Truck A to the distance travelled by Track D?

(a) 17:19 (b) 11:15
(c) 19:17 (d) 15:11
(e) None of these

**[IDBI Bank PO, 2009]**

**225.** What is the average distance travelled by all me trucks together?

(a) 510 Km
(b) 515 Km
(c) 425 Km
(d) 475 Km
(e) None of these

**[IDBI Bank PO, 2009]**

**226.** If Truck A covered the given distance at the average speed of 47.5 Km/h, what was the time taken by it to cover this distance?

(a) 12 hours (b) 10 hours
(c) 8 hours (d) 6 hours
(e) None of these

**[IDBI Bank PO, 2009]**

**227.** The distance travelled by Truck E is approximately what per cent of the total distance travelled by Track B and C together?

(a) 58 (b) 60
(c) 52 (d) 62
(e) 55

**[IDBI Bank PO, 2009]**

**228.** If the time taken by Truck C to cover the given distance was 8 hours, what was the average speed of the truck?

(a) 54.75 Km/h
(b) 65.25 Km/h
(c) 52.25 Km/h
(d) 68.75 Km/h
(e) None of these

**[IDBI Bank PO, 2009]**

**Directions (Question 229 to 233):** Study the following table carefully to answer the questions that follow:
Total number of people In Different Villages and (Of these) Percentage of Men, Women and Children

| Village | Total No. of people | Percentage of men | Percentage of women | Percentage of children |
|---|---|---|---|---|
| L | 1240 | 35 | 45 | 20 |
| M | 2140 | 45 | 30 | 25 |
| N | 1450 | 50 | 30 | 20 |
| O | 1680 | 65 | 20 | 15 |
| P | 2060 | 40 | 40 | 20 |
| Q | 1990 | 40 | 50 | 10 |

**229.** Which village has the least number of children?

(a) L (b) N
(c) Q (d) O
(e) None of these

**[IDBI Bank PO, 2009]**

**230.** What is the ratio of the number of women in Villages L and P together to the number of men in the same villages together?

(a) 617:664
(b) 629:691
(c) 664:617
(d) 691:629
(e) None of these

**[IDBI Bank PO, 2009]**

**231.** What is the total number of women and children together in Village Q?

(a) 995
(b) 1184
(c) 1086
(d) 988
(e) None of these

**[IDBI Bank PO, 2009]**

**232.** The total number of people from Village O is approximately what per cent of the total number of people from all the villages together?

(a) 16 (b) 21
(c) 11 (d) 25
(e) 9

**[IDBI Bank PO, 2009]**

**233.** What is the total number of children from Villages M and N together?

(a) 785 (b) 825
(c) 855 (d) 795
(e) None of these

**[IDBI Bank PO, 2009]**

## ANSWER KEYS

### EXERCISE-I

| | |
|---|---|
| **1.** i, (e) ii, (a) iii, (d), iv, (c) v, (c) | **2.** i, (e), ii, (b), iii, (a), iv, (c) v, (d) |
| **3.** i, (a), ii, (e), iii, (b), iv, (c) v | **4.** i, (c), ii, (a), iii, (d), iv, (b), v, (e) |
| **5.** i, (a), ii, (e), iii, (b), iv, (d), v, (a), vi, (e), vii, (c) | **6.** i, (e), ii, (a), iii, (c), iv, (e), v, (c), |
| **7.** i, (b), ii, (d), iii, (c), iv, (e), v, (a), | **8.** i, (d), ii, (c), iii, (e), iv, (a), v, (b), |
| **9.** i, (a), ii, (c), iii, (d), iv, (b), v, (b), | **10.** i, (b), ii, (e), iii, (b), iv, (e), v, (d), |
| **11.** i, (d), ii, (a), iii, (b), iv, (e), v, (c), | **12.** i, (b), ii, (a), iii, (d), iv, (c), v, (d), |
| **13.** i, (d), ii, (c), iii, (a), iv, (z), v, (c), | **14.** i, (d), ii, (a), iii, (b), iv, (e), v, (b), |
| **15.** i, (e), ii, (a), iii, (e), iv, (c), v, (e), | **16.** i, (a), ii, (a), iii, (a), iv, (e), v, (e), vi, (c), vii, (b), Viii, (e) |
| **17.** i, (a), ii, (c), iii, (e), iv, (d), v, (b), | **18.** i, (a), ii, (d), iii, (e), iv, (c), v, (b) |
| **19.** i, (e), ii, (d), iii, (c), iv, (a), v, (b) | **20.** i, (e), ii, (a), iii, (e), iv, (c), v, (a) |
| **21.** i, (d), ii, (d), iii, (e), iv, (e), v, (e) | **22.** i, (a), ii, (a), iii, (b), iv, (a), v, (b) |
| **23.** i, (a), ii, (d), iii, (a), iv, (d), v, (d) | **24.** i, (b), ii, (c), iii, (d), iv, (d), v, (c), |
| **25.** i, (d), ii, (b), iii, (a), iv, (a), v, (b) | **26.** i, (c), ii, (d), iii, (d), iv, (d), v, (b) |
| **27.** i, (a), ii, (e), iii, (d), iv, (b), v, (c) | **28.** i, (d), ii, (e), iii, (b), iv, (c), v, (e) |
| **29.** i, (c), ii, (a), iii, (d), iv, (a), v, (d) | **30.** i, (a), ii, (d), iii, (b), iv, (c), v, (b) |
| **31.** i, (c), ii, (b), iii, (a), iv, (e), v, (d) | **32.** i, (b), ii, (d), iii, (e), iv, (a), v, (c), vi, (b), vii, (d), viii, (a) |
| **33.** i, (a), ii, (c), iii, (a), iv, (d), v, (b) | **34.** i, (b), ii, (a), iii, (d), iv, (a), v, (c) |
| **35.** i, (e), ii, (d), iii, (e), iv, (b), v, (e) | **36.** i, (b), ii, (c), iii, (d), iv, (e), v, (e) |
| **37.** i, (b), ii, (d), iii, (e), iv, (c), v, (b) | **38.** i, (a), ii, (c), iii, (d), iv, (b), v, (a) |
| **39.** i, (e), ii, (c), iii, (c), iv, (b), v, (d) | **40.** i, (e), ii, (d), iii, (a), iv, (b), v, (c) |

### EXERCISE-2

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (a) | **3.** (c) | **4.** (c) | **5.** (b) | **6.** (d) | **7.** (d) | **8.** (b) | **9.** (c) | **10.** (b) | **11.** (c) | **12.** (d) |
| **13.** (b) | **14.** (b) | **15.** (b) | **16.** (d) | **17.** (b) | **18.** (c) | **19.** (c) | **20.** (c) | **21.** (d) | **22.** (d) | **23.** (c) | **24.** (d) |
| **25.** (a) | **26.** (b) | **27.** (c) | **28.** (d) | **29.** (d) | **30.** (a) | **31.** (d) | **32.** (b) | **33.** (c) | **34.** (d) | **35.** (c) | **36.** (a) |
| **37.** (b) | **38.** (a) | **39.** (a) | **40.** (c) | **41.** (b) | **42.** (a) | **43.** (c) | **44.** (d) | **45.** (d) | **46.** (b) | **47.** (b) | **48.** (a) |
| **49.** (c) | **50.** (b) | **51.** (d) | **52.** (d) | **53.** (b) | **54.** (d) | **55.** (a) | **56.** (b) | **57.** (c) | **58.** (d) | **59.** (d) | **60.** (a) |
| **61.** (d) | **62.** (c) | **63.** (b) | **64.** (e) | **65.** (d) | **66.** (d) | **67.** (b) | **68.** (d) | **69.** (b) | **70.** (d) | **71.** (a) | **72.** (a) |
| **73.** (b) | **74.** (b) | **75.** (a) | **76.** (b) | **77.** (a) | **78.** (a) | **79.** (b) | **80.** (c) | **81.** (d) | **82.** (a) | **83.** (a) | **84.** (c) |
| **85.** (b) | **86.** (c) | **87.** (b) | **88.** (a) | **89.** (b) | **90.** (c) | **91.** (d) | **92.** (e) | **93.** (a) | **94.** (b) | **95.** (c) | **96.** (d) |
| **97.** (a) | **98.** (d) | **99.** (c) | **100.** (e) | **101.** (e) | **102.** (e) | **103.** (c) | **104.** (c) | **105.** (d) | **106.** (e) | **107.** (a) | **108.** (d) |
| **109.** (b) | **110.** (c) | **111.** (e) | **112.** (c) | **113.** (e) | **114.** (d) | **115.** (c) | **116.** (a) | **117.** (e) | **118.** (c) | **119.** (a) | **120.** (d) |
| **121.** (b) | **122.** (a) | **123.** (b) | **124.** (c) | **125.** (a) | **126.** (d) | **127.** (b) | **128.** (d) | **129.** (b) | **130.** (e) | **131.** (d) | **132.** (a) |
| **133.** (b) | **134.** (c) | **135.** (b) | **136.** (a) | **137.** (e) | **138.** (c) | **139.** (a) | **140.** (d) | **141.** (c) | **142.** (e) | **143.** (d) | **144.** (a) |
| **145.** (e) | **146.** (c) | **147.** (c) | **148.** (b) | **149.** (e) | **150.** (a) | **151.** (e) | **152.** (c) | **153.** (c) | **154.** (a) | **155.** (b) | **156.** (d) |
| **157.** (d) | **158.** (a) | **159.** (b) | **160.** (c) | **161.** (a) | **162.** (b) | **163.** (e) | **164.** (d) | **165.** (a) | **166.** (e) | **167.** (a) | **168.** (b) |
| **169.** (a) | **170.** (e) | **171.** (c) | **172.** (c) | **173.** (b) | **174.** (d) | **175.** (e) | **176.** (b) | **177.** (d) | **178.** (c) | **179.** (e) | **180.** (b) |
| **181.** (e) | **182.** (e) | **183.** (e) | **184.** (d) | **185.** (a) | **186.** (a) | **187.** (d) | **188.** (c) | **189.** (a) | **190.** (b) | **191.** (c) | **192.** (c) |
| **193.** (d) | **194.** (b) | **195.** (a) | **196.** (d) | **197.** (d) | **198.** (c) | **199.** (e) | **200.** (b) | **201.** (b) | **202.** (b) | **203.** (c) | **204.** (c) |
| **205.** (d) | **206.** (b) | **207.** (a) | **208.** (c) | **209.** (e) | **210.** (a) | **211.** (b) | **212.** (c) | **213.** (d) | **214.** (a) | **215.** (e) | **216.** (b) |
| **217.** (d) | **218.** (c) | **219.** (e) | **220.** (d) | **221.** (a) | **222.** (b) | **223.** (c) | **224.** (c) | **225.** (d) | **226.** (b) | **227.** (d) | **228.** (d) |
| **229.** (c) | **230.** (d) | **231.** (e) | **232.** (a) | **233.** (b) | | | | | | | |

## EXPLANATORY ANSWERS

### EXERCISE-1

**1. (ii) (a)** Required difference = 60 − 50 = 10,000 tonne.

**(iii) (d)** Percentage increase in production

$$= \frac{15}{25} \times 100 = 60\%$$

**(iv) (c)** Average production

$$= \frac{25+40+60+45+65+50+70+80}{8}$$

$$= \frac{440}{8} = 55.$$

**(v) (c)** Required percentage drop

$$= \frac{60-45}{60} \times 100 = 25\%$$

**2. (i) (e)** We can use the direct formula for

$$\text{Profit} = \text{Income}\left[1 - \frac{100}{100 + \%\ \text{Profit}}\right]$$

We see that the profit is maximum in 1998.

**(ii) (b)** Total expenditure

$= 120 \times \frac{100}{107.5} + 160 \times \frac{100}{115} + 130 \times \frac{100}{122.5}$

$+ 170 \times \frac{100}{117.5} + 190 \times \frac{100}{120} + 150 \times \frac{100}{127.5}$

= ₹777.51 Lakhs

$\therefore$ Average $= \frac{777.51}{6} \approx$₹1300 Lakh.

**(iii)** **(a)** Per cent profit increase/decrease from the previous year

| 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| 100 | 50 | (–)22.22 | 14.28 | 37.5 |

**(iv)** **(c)** Expenditure in $1994 = 160 \times \frac{100}{115} \approx 140$ Lakh

**(v)** **(d)** Expenditure in $1997 = 110 \times \frac{100}{125} =$₹152 Lakh.

**3.** **(i)** **(a)** Production of C type cars in 1996
= (70 – 40)% of 450000
= 30% of 450000 = 135000
Production of C type cars in 1997
= (65 – 40)% of 520000
= 25% of 520000 = 130000
$\therefore$ Required difference = 5000.

**(ii)** **(e)** Production of E type cars in 1996
= (100 – 80)% of 450000
= 20% of 450000 = 90000
And in 1997 = 10% of 520000 = 52000
$\therefore$ Total production = 90000 + 52000 = 142000.
$\therefore$ Required number of cars = 15% of 142000 = 21300

**(iii)** **(b)** Production of *A* type cars in 1997 = production of *A* type cars in 1996 (given) = (100 – 85) 5% of 450000 = 67500

$\therefore$ Required percentage $= \frac{67500}{520000} \times 100 \approx 13.$

**(iv)** **(c)** Clearly, by visual inspection *D* is the desired option.

**(v)** **(c)** Percentage production of *B* type cars in 1997 = that in 1996 (given)
= (40 – 15) 25% of 520000 = **130000.**

**4.** **(i)** **(c)** Total rose production = (15 + 12.5 + 12.45 + 20 + 12.4 + 22.5 + 22.4 + 25) × 1000
= 142250
Percentage production of rose in the States (the lowest four states)

| Rajasthan | Karnataka | Haryana | Gujarat |
|---|---|---|---|
| 8.71 | 8.75 | 8.78 | 10.54 |

**(ii)** **(a)** Required percentage

$= \frac{25-20}{20} \times 100 = 25\%$(more)

**(iii)** **(d)** Total production of rose by all the States = 142250

$\therefore$ Average $= \frac{142250}{8 \times 1000} \approx 18$ thousand.

**(iv)** **(b)** Required percentage

$= \frac{25}{142.25} \times 100 \approx 20\%$

**(v)** **(e)** It is 36.8% approximately.

**5.** **(i)** **(a)** Required $\% = \frac{5.1}{12.5} \times 100 = 40.8\%$

**(ii)** **(e)** Percentage increase

$= \frac{38.8 - 11.8}{11.8} \times 100 \approx 225\%$

**(iv)** **(d)** Required Ratio $= \frac{7.4}{16.8} = 37 : 84.$

**(v)** **(a)** Required $\% = \frac{38.8}{63.9} \times 100 \approx 60\%$

**(vi)** **(e)** Required $\% = \frac{101.80}{138.50} \times 100 \approx 75\%$

**(vii)** **(c)** Required $\% = \frac{1.8}{74.6} \times 100 = 2.41\%$

**6.** **(i)** **(e)** Sale of Pep-up was the maximum in the year 1989.

**(ii)** **(a)** Avg. annual sale of Dew-drop

$= \frac{10+15+25+15+30+25}{6} = 20$ Lakh

Average annual sale of Cool-sip

$= \frac{25 + 7 + 2C + 20 + 25 + 30}{6} = 21.16$ Lakh

Average annual sale of Pep-up

$= \frac{30+35+30+25+20+20}{6} = 26.66$ Lakh.

**(iii)** **(c)** Required $\% = \frac{25-20}{20} \times 100 = 25\%$

**(iv)** **(e)** Required number = 30 – 20 = 1000000.

**(v)** **(c)** Required % drop $= \frac{35-30}{35} \times 100 \approx 14\%$

**7.** **(i)** **(b)** Obvious from the chart.

**(ii)** **(d)** Total imports in the given years
= 35 + 30 + 40 + 50 + 55 + 60 + 45
= 315 Crore

Total exports in the given years

= 40 + 45 + 35 + 40 + 60 + 50 + 55

= 325 Crore

Hence, require ratio $= \frac{315}{325} = \frac{63}{65}$.

**(iii)** **(c)** Obvious from the chart.

**(iv)** **(e)** Total exports in the years 1995, 1996 and 1999

= 35 + 40 + 55 = 130 Crore

Total imports in the years 1995, 1996 and 1999

= 40 + 50 + 45 = 135 Crore

Now required $\% = \frac{130 \times 100}{135} = 96.29\%$

**(v)** **(a)** If you calculate approximate value you reject (b), (c) and (d). Now check (a).

In 1996, % increase in export

$= \frac{5}{35} 100 = \frac{100}{7} = 14.29\%$

**8.** **(i)** **(d)** $\frac{(110 + 60 + 110 + 100 + 105 + 85) = 570}{6}$

= 95 Lakh tons

**(ii)** **(c)** Average production of units A, B and C in 2001[use white bars]

$= \frac{(90 + 75 + 100) = 265}{3}$

Average production of units $D$, $E$ and $F$ in 2002

$= \frac{(100 + 105 + 85) = 290}{3}$

∴ Required answer $= \frac{265 \times 3}{3 \times 290} \times 100 = 91.38$.

**(iii)** **(e)** Total production by unit $B$ in 2001 and 2002 together

= (75 + 60) = 135 Lakh tons

Total production by unit $C$ in 2001 and 2002 together

= (100 + 110) = 210 Lakh tons

∴ Required ratio = (135:210) = 9:14.

**(iv)** **(a)** Total production by unit F in year 2001 and 2002 together

= (70 + 85) = 155 Lakh tons

∴ Required percentage $= \left(\frac{155}{195} \times 100\right)$

= 79.487 ≈ 79.49.

**(v)** **(b)** Required total production

=(100 + 110 + 95 + 100 + 85 + 105)

= 595 Lakh tons.

**9.** **(i)** **(a)** % growth of expense from 1994 to 1995

$= \frac{400 - 300}{300} \times 100 = 33\frac{1}{3}\%$ 0

% growth of expense from 1995 to 1996 = 0

% growth of expense from 1996 to 1997

$= \frac{600 - 400}{400} \times 100 = 50\%$

% growth of expense from 1997 to 1998

$= \frac{700 - 600}{600} \times 100 = 16\frac{2}{3}\%$

∴ average $= \frac{100}{4} = 25\%$

**(iii)** **(d)** Average $= \frac{100 - 200 + 100 + 400}{4} =$ ₹100 crore

**(iv)** **(b)** Ratio of profit to capital

| 1998 | 1995 | 1996 | 1997 |
|---|---|---|---|
| 0.50 | 1 | – 1 | – 1 |

**10.** **(i)** **(b)** Required percentage drop

$= \frac{25 - 22.5}{25} \times 100 = 10\%$

**(ii)** **(e)** Required difference = (35 – 22.5) Lakhs = 1250000.

**(iii)** **(b)** Only by visual observation you can find the answer. You do not need to calculate the values. I (iv) (e) Production of $B$ type cars is more than the production of $C$ type cars only in 1993, 1994 and 1995. We see the largest difference exists in 1995. So, the answer is 1995.

**(v)** **(d)** Total production of $C$ type tyres in 1992 and 1993 together

= (30 + 25) = 55 Lakhs and that of $B$ in 1994 = 27.5 Lakhs.

∴ Required Percentage $= \frac{55}{27.5} \times 100 = 200$.

**11.** **(i)** **(d)** Difference of production of $C$ in 1991 and $A$ in 1996 = 500000 tonnes

**(ii)** **(a)** Percentage increase of $A$ from 92 to 93

$= \frac{55 - 40}{40} \times 100 = 37.5\%$

**(iii)** **(b)** Percentage rise/fall in production for $B$

| 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|
| 9% | – 16.6% | 10% | – 8% | 10% |

**(iv)** **(e)** Percentage production $= \frac{120}{90} \times 100 = 133.3\%$

**(v)** **(c)** Average production of $A$ = 50

Average production of $B$ = 54.17

Average production of $C$ = 50 1996 10%

Difference of production = 54.17 – 50 = 4.17.

**12.** **(i)** **(b)** $\frac{(7500-5300=)2200\times 100}{705300}=41.5\%$

**(iv)** **(c)** Let, GTR be ₹$x$

$\therefore$ $x - x \times 10\% = 5800$

$\therefore$ $x=\frac{5800\times 10}{9}=$₹6444.4.

**(v)** **(d)** 8800 − 5100 = 3700.

**13.** **(ii)** **(c)** Our intelligent observation says that the required year cannot be 1993, 1994, 1995. Why? Because see the following conclusions:

% passed to appear $=\frac{\text{Passed}}{\text{Appeared}}\times 100$

% of passed to appear is least when $\frac{\text{Passed}}{\text{Appeared}}$ is the least

or, $\frac{\text{Appeared}}{\text{Passed}}$ is the most. Now, we do the further calculations mentally. See the following conclusions:

For 1990: $\frac{7894}{2513}\Rightarrow$ Quotient = 3 and Remainder ≈ 300

For 1991: $\frac{8562}{2933}\Rightarrow Q=3$ and $R\approx 400$

For 1992: $\frac{8139}{2468}\Rightarrow Q=3$ and $R\approx 800$

Similarly, for 1993; 1994, 1995, $Q$ is 2.

So, 1992 gives the highest value.

**(iii)** **(a)** $\frac{8562-8139}{8562}\times 100=\frac{423}{8562}\times 100\approx\frac{42}{84}\times 10=5$

**(iv)** We do not need to calculate the values for each year. Follow as:

For Rural area: 35% of 5032 ≈ 35 × 50 = 1750 ≈ 1798

For Semi-urban area: 35% of 9500 ≈ 35 × 95 ≈ 3300

Which cannot be approximated to 3500.

For State capitals: 35 × 85 = 3000

For Metropolises: 35 × 110 = 3850

**(v)** **(c)** 1798 + 2513 = 4311.

**14.** **(i)** **(d)** Distance to be travelled by each type of vehicle

$=\frac{15}{3}=5$ Km

Since, to travel 5 Km by vehicle $A$, he will pay ₹9 for 4 Km and for the next 1 Km he will have to pay

₹ $\frac{13.5-9.00}{(7-4)}\times 1.$

Similarly, for other cases.

Fare by $A=$ ₹$9+\frac{13.50-9}{7-4}$ = 9 + 1.50 = ₹10.50

Fare by $B=14.50+\frac{24.25-14.50}{7-4}$

$=14.50+3.25=17.75$

Fare by $C=19+\frac{31-19}{3}=19+4=23$

Total fare = 10.50 + 17.75 + 23 = ₹ 51.25.

**(ii)** **(a)** Fare by $A=9+\frac{4.50}{3}\times 2=$ ₹12

Fare by $B=24.25+\frac{33.25-24}{3}\times 2=$ ₹30.25

Total fare = 30.25 + 12 = ₹42.25.

**(iii)** **(b)** Fare, for 8 Km by $A=13.50+\frac{17.25-13.50}{10-7}$

$=13.50+\frac{3.75}{3}=$ ₹14.75

Fare by $B=24.25+\frac{33.25-24.25}{3}=$ ₹27.25

Difference = 27.25 − 14.75 = ₹12.50.

**(iv)** **(e)** Fare by B for 5 Ian = 14.50 + 3.25 = ₹17.75

Fare by A for 8 Km $=13.50+\frac{17.25-13.50}{3}=$ ₹14.75

Fare by $C$ for 5 Km $=19+\frac{31-19}{3}=$ ₹23

Total fare = 17.75 + 1475 + 23 = 55.50.

**(v)** **(b)** Fare for 14th Km by $C=\frac{56.50-41.50}{15-10}=$ ₹3

Fare for 9th Km by $B=\frac{33.25-24.25}{10-7}=$ ₹3.

**15.** **(i)** **(e)** Average runs of $A=\frac{994}{19}=52.31$

Average runs of $B=\frac{751}{18}=41.72$

Difference = 52.31 − 41.72 = 10.59.

**(ii)** **(a)** Average runs of $C=\frac{414-52}{17}=21.29.$

**(iii)** **(e)** Difference between two highest runs

= 994 − 772 = 222

Difference between two lowest runs

= 653 − 414 = 239

Difference = 239 − 222 = 17.

**(iv)** **(c)** Ratio of A and D = 141:94 = 3:2.

**(v)** **(e)** Without knowing the individual runs of 8 openers, we cannot find the average runs of remaining batsmen.

**16.** **(i)** **(a)** Avarage $=\frac{52+66+64+75+58}{5}=\frac{315}{5}=63.$

**(ii)** **(a)** The difference is 9.

**(iii)** **(a)** Percentage increase $= \frac{55-46}{46} \times 100 \approx 20\%$

**(iv)** **(e)** Average highest marks $= \frac{85+80+75}{3} = \frac{240}{3} = 80.$

**(vi)** **(c)** Required percentage $= \frac{80}{64} \times 100 = 125\%$

**(vii)** **(b)** Marks obtained by students = 50 × 60 = 3000.

**(viii)** **(e)** The maximum difference is in the years 1992 and 1997, since the least value is in 1992 and the highest value is in 1997.

**17.** **(i)** **(a)** Total number of students studying in all schools in 1992 = (1025 + 230 + 190 + 950 + 350 + 225 + 1100 + 320 + 300

+ 1500 + 340 + 300 + 1450 + 250 + 280) − (120 + 110 + 150 + 115 + 130 + 150 + 150 + 160 + 125 + 130)

= 8810 − 1340 = 7470

$\therefore$ Average $= \frac{7470}{5} = 1494.$

**(ii)** **(c)** Number of students studying in school B in 1994 = 950 + (350 − 150) + (225 − 115) + (185 − 110) + (200 − 90) = 950 + 200 + 110 + 75 + 110 = 1445.

**(iii)** **(e)** Number of students leaving school C from 1990 to 1995

= 130 + 150 + 125 + 140 + 180 = 725

Number of students admitted during the period

= 1100 + 320 + 300 + 260 + 240 + 310 = 2530 =2530

$\therefore$ Required percentage $= \frac{725}{2530} \times 100 \approx 29\%$

**(iv)** **(d)** Required difference

= (340 + 300 + 295 + 320 + 360) − (350 + 225 + 185 + 200 + 240) = 1615 − 1200 = 415.

**(v)** **(b)** Increase in number of students in school $A$ = (230 − 120) + (190 − 110) + (245 − 100) + (280 − 150) + (250 − 130) = 585

$\therefore$ % increase from 1990 (1025) to 1995

$= \frac{585}{1025} \times 100 = 57.07\%$

Similarly, we can calculate for other schools.

**18.** **(i)** **(a)** Number of females above poverty line in State $A$

$= 3000 \times (100-12)\% \times \frac{3}{7} \approx 1200.$

**(ii)** **(d)** Since we cannot find the population of States $C$ and $D$ separately, we cannot find the required value.

**(iii)** **(e)** Population of State A below poverty line

$= 3000 \times \frac{5}{3} = 5000$

$\therefore$ Total population of State $A = \frac{5000}{12} \times 100$

and the population of State $E$ below poverty line

$= 6000 \times \frac{11}{6} = 11000$

$\therefore$ Total population of State $E = \frac{11000}{10} \times 100$

$\therefore$ Required ratio $= \frac{5}{12} \times \frac{10}{11} = \frac{25}{66}.$

**(iv)** **(c)** Total population of State $B$

$= 500\left(\frac{12}{5}\right)\left(\frac{100}{15}\right) = 8000.$

**(v)** **(b)** Population of State $E$

$= 19800\left(\frac{5}{2}\right)\left(\frac{100}{100-10}\right) = 55000$

$\therefore$ Population of males below poverty line.

$= \frac{6}{11} \times 55000 = 30000.$

**19.** **(i)** **(e)** Required per cent $= \frac{152.2}{86.4} \times 100 \approx 175\%$

**(iii)** **(c)** Average production of pulse

$= \frac{20.5+22.4+24.6+23.5+27.8+28.2}{2}$

$= \frac{147.0}{6}$

24.5 million tonne.

**(iv)** **(a)** Required percentage $= \frac{32.4}{450} \times 100 = 7.2\%$

**(v)** **(b)** Total production of oilseeds in the given years = 42.4 + 46.8 + 52.4 = 141.6

which is equal to the production of wheat in 1994 − 95.

**20.** **(i)** **(e)** The difference between the white-coloured cars sold is the minimum in $B$ type model.

**(ii)** **(a)** Blue ($E$ + $D$) = 37 + 43 = 80 = White ($B$).

**(iii)** **(e)** Required difference = (50 − 34) × 1000 = 16000.

**(iv)** **(c)** Required percentage $= \frac{173}{192} \times 100 \approx 90\%$

**(v)** **(a)** While-C Colour-model combination of car in Metro $M$

**21.** **(i)** **(d)** Total number of students who play cricket = 38 + 40 + 12 + 17 + 25 + 18 + 20 = 170

Required% $= \frac{25}{170} \times 100 \approx 15\%$

**(ii)** **(d)** Required ratio = 27:18 = 3:2.

**(iv)** **(e)** Total Class $X$ students who play different games = 115

Required % $= \frac{21}{115} \times 100 \approx 18\%$

**(v)** **(e)** Basketball and Badminton are the two games which satisfy the conditions.

**22.** **(i)** **(a)** Maximum population shows the age group up to 15 years, but among the options it is not there. Hence, among the given options age group 16 – 25 is responsible for maximum population.

**(ii)** **(a)** Required number = 47.75% of 4200 ≈ 2006.

**(iii)** **(b)** Number of people in the age group 56 – 65

$= \frac{200}{65} \times 5.12 \approx 15.75.$

**(iv)** **(a)** Required. difference in the population

$= \frac{10}{5.12} \times 3.50 \approx 6.8$ million.

**(v)** **(b)** Total population

$= \frac{11.75}{3} \times 100 \approx 391.67$ million.

**23.** **(i)** **(a)**Total Sales – Gross Profit in

1990 = 351.6 – 155.5 = 196.1;

1991 = 407.9 – 134.3 = 273.6

1992 = 380.1 – 149.9 = 230.2;

1993 = 439.7 – 160.5 = 279.2

1994 = 485.9 – 203.3 = 282.6

**(ii)** **(d)** Let, 439.7 = $K$% of 351.6 ⇒ $K$ = 125.

**(iv)** **(d)** Let, 42.6 = $K$% of 439.7 $\Rightarrow K = \frac{4260}{439.7} = 9.7.$

**(v)** **(d)** Per cent increase in the gross profit:

From 1991 to 1992: $\frac{15.6}{134.3} \times 100 = 11.6\%$

From 1992 to 1993: $\frac{10.6}{149.9} \times 100 = 7.07\%$

From 1993 to 1994: $\frac{42.8}{160.5} \times 100\ 26.67\%$

**24.** **(ii)** **(c)** Total production of rice

= 45 + 48 + 59 + 41 + 37 + 68 + 57 + 38

= 393 Lakh tons

Total production of wheat

= 103 + 86 +32 + 37 + 22 + 15 + 8 + 28

= 331 Lakh tons

∴ Required proportion = 393:331 ≈ 12:1.

**(iv)** **(d)** Total wheat production in the country = 331 Lakh tons and state P alone produces 103 Lakh tons of wheat

Required percentage $= \frac{103}{331} \times 100 \approx 30\%$

**(v)** **(c)** Total rice production in the country = 393 Lakh tons

Yield per hectare = 30 tons

∴ Area under rice cultivation $= \frac{393}{30} \approx 13$ Lakh hectares.

**25.** **(i)** **(d)** 146947 – (65104 + 60387) = 21456.

**(ii)** **(b)** 146947 + 11630 = 158577.

**(iii)** **(a)** 158577 – (70391 + 62516) = 25.670.

**(iv)** **(a)** 153922 – (5337 + 21560 + 69395) = 57630.

**(v)** **(b)** 160998 – (153922 – 5337) = 12413.

**26.** **(i)** **(c)**Average of the total prod. during the period

$= \frac{476}{6} \approx 80.$

**(ii)** **(d)** Answer will be 1993.

**(iv)** **(d)** 25% of 80 = 20 = production of S's car in 1993.

**(v)** **(b)** Required percent increase $= \frac{90-75}{75} \times 100 = 20\%$

**27.** **(i)** **(a)** Required ratio $= \frac{8+9}{15+18} = 17:33.$

**(ii)** **(e)** Here, do not find the ratio of the number of qualified candidates that of the appeared. Simply check the ratio of % qualified candidates with respect to the appeared is the least for which state. Ans. = $G$.

**(iii)** **(d)** Required difference = (21 – 13)% of 9000 = 720.

**(iv)** **(b)** Required $\% = \frac{(16+7)\% \text{ of } 9000}{(11+8)\% \text{ of } 45000} \times 100 = 24.21\%$

**(v)** **(c)** Required ratio $= \frac{(16+21)\% \text{ of } 9000}{8\% \text{ of } 45000}.$

**28.** **(i)** **(d)** Required ratio $= \frac{14\% \text{ of } 3800}{14\% \text{ of } 4200} = 19:21.$

**(ii)** **(e)** Required number = 27% of 3800 = 1026.

**(iii)** **(b)** Required number = 31 % of 4200 = 1302.

**(iv)** **(c)** Required number = 8% of 3800 + 17% of 4200

= 304 + 714 = 1018.

**(v)** **(e)** Required ratio $= \frac{14\% \text{ of } 3800}{17\% \text{ of } 4200} = 19:17.$

**30.** **(i)** **(a)** 40% of 15000000 = 6000000.

**(ii)** **(d)** 12.5% of 12000000 = 1500000.

**(iii)** **(b)** 15:15 = 1:1.

**(v)** **(b)** 12.5% in each

**32.** **(i)** **(b)** Total cost $= \frac{2}{5} \times \frac{15}{100} \times 25 + \frac{4}{5} \times \frac{22}{100} \times 25$

= 1.5 + 4.4 =5.9 Crore

**(ii)** **(d)** Amount of profit earned by company $D$ on item II

$= \frac{5}{8} \times \frac{8}{100} \times 25 \times \frac{25}{100} = 31.25$ Lakhs

**(iii)** **(e)** Cost of production of item I by company $F$

$= \frac{1}{5} \times \frac{5}{100} \times 25 = 0.25$ crores

Cost of production of item II by company $D$

$= \frac{5}{8} \times \frac{8}{100} \times 25 = 1.25$ crore

$\therefore$ Required % $= \frac{0.25}{1.25} \times 100 = 20\%$

**(iv) (a)** Total profit earned by company G

$= \frac{1}{3} \times \frac{12}{100} \times 25 \times \frac{30}{100} + \frac{2}{3} \times \frac{12}{100} \times 25 \times \frac{24}{100}$

= 0.3 + 0.48 = ₹78 Lakhs.

**(v) (c)** Required ratio $= \dfrac{\frac{2}{5} \times \frac{12}{100} \times 25}{\frac{3}{8} \times \frac{8}{100} \times 28} = 2{:}1.$

**(vi) (b)** Required profit

$= \frac{3}{5} \times \frac{11}{100} \times 25 \times \frac{32}{100} + \frac{3}{5} \times \frac{15}{100} \times 25 \times \frac{20}{100}$

= 0.528 + 0.450 = ₹97.8 Lakhs.

**33. (i) (a)** Total number of students for course $D$ = 35% of 1200 = 420

Number of girl students for course $D$ = 30% of 800 = 240

Number of boy students for course D = 420 − 240 = 180

Required ratio = 180:240 = 3:4.

**(ii) (c)** Number of boys for difference courses are

$A$ = 0; $B$ = 100; $C$ = 44; $D$ = 180; $E$ = 32; $F$ = 44.

**(iii) (a)** Number of girls for course E = 14% of 800 = 112

Number of boys for course E = 32

Required more % $= \frac{112 - 32}{32} \times 100 = 250\%$

**(iv) (d)** Using the information given in $Q$. Number (2)

**(v) (b)** Number of girls in course $C$ = 2 % of 800 = 16.

**34. (i) (b)** 23% of 46000 = ₹10580.

**(ii) (a)** 25% of 46000= ₹11500.

**(iii) (d)** Required ratio = 15:12 = 5:4.

**(iv) (a)** 23%

**(v) (c)** 15% of 46000 = ₹6900.

**35. (i) (e)** $\%\text{ Profit} = \frac{\text{Income} - \text{Expenditure}}{\text{Expenditure}} \times 100$

or, $45 = \frac{140 - E}{E} \times 100$

or, $\frac{140}{E} = \frac{45}{100} + 1 = \frac{9}{20} + 1 = \frac{29}{20}$

$\therefore E = 140\left(\frac{20}{29}\right) = 96.6$ crores

**(ii) (d)** $I_{93} = E_{94}\left(\frac{100+50}{100}\right) = \frac{3}{2}E_{93}$

$I_{94} = E_{94}\left(\frac{100+50}{100}\right) = \frac{3}{2}E_{93}$

$I_{94} = E_{94}\left[\frac{100+40}{100}\right] = \frac{7}{5}E_{94}$

$E_{93} + E_{94} = 279$

But we cannot find $\frac{3}{2}E_{93} + \frac{7}{5}E_{94}$.

Hence, we cannot solve it.

**(iii) (e)** $E = I\left(\frac{100}{100+P}\right)$

or, $\frac{E}{I} = \frac{100}{100+P}$ ...(1)

We require $\frac{E}{I} \leq 50\%$ or, $\leq \frac{E}{I}\ \frac{1}{2}$

Now, from (1), $\frac{100}{100+P} \leq \frac{1}{2}$

So, the value of $P$ should be more than 100, which is not correct for any of the given years.

**(iv) (b)** $I = E\left[\frac{100 + \%\text{Profit}}{100}\right]$

$= 200\left(\frac{100+40}{100}\right)$ crores $= 280$ crores

**(v) (e)** $I > 2E$

$\Rightarrow$ Profit % is more than 100, which is not correct for any of the given years.

**36. (ii) (c)** Average percentage increase of the commodities

| January | February | March | April | June |
|---|---|---|---|---|
| 16.25% | 23.75% | 28.75% | 35% | 41.25% |

**(iv) (e)** Sale of commodity $C$ in July $= 100 \times \frac{95}{100} = 95.$

**37. (i) (b)** Let, the investment of company $B$ in 1996 be ₹$x$ Lakhs.

$\therefore$ Investment of company $B$ in 1997 = ₹$\frac{7}{5}x$

Income of company $B$ in 1997 $= \frac{9}{5} \times \frac{7}{5}x = \frac{63}{25}x$

**(ii) (d)** Required $\% = \frac{63}{25} \times 100 = 252\%$

**(iii) (e)** Investment of company $A$ in 1995

$= 21.7 \times \frac{100}{155} = 14$ Lakhs

**(iv) (c)** Let, ${}^{i}95_{(A)} = {}^{e}96_{(B)} = ₹x$ Lakh

$$\therefore \quad \text{Required ratio} = \frac{x \times \frac{100}{155}}{x} = 20:31.$$

**(v) (b)** Income of company $B$ in 1993

$$= 1540000 \times \frac{145}{100} = ₹22.33 \text{ Lakhs.}$$

**38. (i) (a)** Income of Company $B$ in 2000

$$= 200 \times \frac{120}{100} = ₹240 \text{ Crores}$$

**(ii) ( c)** Expenditure of Company $A$ in 2002

$$= 600 \times \frac{100}{160} = ₹375 \text{ Crores}$$

**(iii) (d)** We can find out the amount of profit in 1998, we do not know the income and expenditure of $A$ and $B$, therefore option (d) is the correct choice.

**(iv) (b)** Ratio of their expenditures

$$= \frac{100}{135} \times \frac{130}{100} = 26:27.$$

**(v) (a)** Required % Increase $= \frac{35-20}{20} \times 100 = 75\%$

**39. (i) (e)** Suppose in the year 1998–99 expenditure of company $X = ₹a$

Then profit earned by company $X$ in this year

= ₹ (30% of a)

Hence, income of company $X$ = ₹(130% of $a$)

Again, expenditure of company $Y$ in 2001–02

$$= ₹\frac{a + 130}{100}$$

Hence, profit earned by company $Y$ in 2001–02

$$= ₹\frac{a \times 130}{100} \times \frac{50}{100}$$

Thus, required ratio

$$= \frac{\frac{30}{100} \times a}{\frac{a \times 130}{100} \times \frac{50}{100}} = \frac{30}{100} \times \frac{100 \times 100}{130 \times 50} = \frac{30}{65} = 6:13.$$

**(ii) (c)** $I_{x2002-02} = E_{x2002-03} = \frac{I_{x2002-03}}{1.5}$

$$I_{x2002-02} = 1_{x2002-03} = \frac{2}{3} = 2:3.$$

**(iii) (c)** Per cent of increase in percent profit over that of the previous year for the given years is as follows:

Year

$1998-99: \frac{(20-15)}{15} \times 100 = 33.33\%$

$1999-00: \frac{(30-20)}{20} \times 100 = 50\%$

2000 – 01 : = 0%

$2001-02: \frac{(50-30)}{30} \times 100 = 66\frac{2}{3}\%$

$2002-03: \frac{(60-50)}{50} \times 100 = 20\%$

You do not need to do any rough work. See the graph and search for steep rise in the line joining the two Δ's.

**(iv) (b)** Required income

= 120% of ₹40 Crore = ₹48 Crore

**(v) (d)** The given graph depicts only the per cent profit earned by the two companies over the given years. Hence, these information are insufficient to answer the question.

(vi) (e) In 2002–03 profit earned by company $Y$ was 60%

There fore, 160% of expenditure ₹128 crore

Thus, required expenditure $= \frac{128}{160} \times 100 = ₹80$ Crores

**40. (i) (e)** Average imports made by company $A$

$$= \frac{30 + 50 + 60 + 40 + 70 + 60 + 75}{7} = \frac{385}{7} = 55$$

In none of the given years the imports is exactly equal to 55 (Crore). Hence, the answer is (e).

**(ii) (d)** By visual inspection it is clear that 1992 is the desired year (as the distance between two points is the maximum in 1992).

**(iii) (a)** By mental observation $\left(\text{as } 50 = \frac{40 + 60}{2}\right)$, 1992 only is the desired year. You do not need any calculation.

See the year where the point A lies exactly in the middle of points of $B$ and $C$.

**(iv) (b)** Required percentage increase $= \frac{50 - 40}{40} \times 25\%$

**(v) (c)** The total imports (in Crore) made by all the three companies together: From the heights of the points we observe that the total heights of three points is the maximum either in 1995 or 1997. If you observe carefully, our clear answer is 1995, but to be sure we find actual values for the two years.

In 1995 = 70 + 80 + 85 = 235.

In 1997 = 75 + 70 + 85 = 230.

Clearly, 1995 is the desired year.

## EXERCISE-2
## (BASED ON MEMORY)

**1. (a)** Required average

$= \left(\frac{5+4+4+3+4}{5}\right)$ million tonnes

= 40 Lakhs tonnes

**2. (a)** $\because$ $360° \equiv 9000$ tonnes

$\therefore$ $110° \equiv \frac{9000 \times 110}{360} = 2750$ tonnes

**3. (c)** Percentage decrease

$= \frac{32-27}{32} \times 100$

$= \frac{5 \times 100}{32} = \frac{125}{8} = 15\frac{5}{8}\%$

**4. (c)** Required average

$= \frac{100+220+300+200+250}{5} = \frac{1070}{5} = 214$

**5. (b)** Required percentage $= \frac{70+80}{205} \times 100 = 73.17\%$

**6. (d)** Required ratio = (75 + 65):(85 + 95)

= 140:180 = 7:9

**7. (d)** Average sales of branches $B_1$, $B_2$ and $B_3$ in 2001

$= \frac{105+65+110}{3} = \frac{280}{3}$

Average sales of branches $B_1$, $B_3$ and $B_6$ in 2000

$= \frac{80+95+70}{100} = \frac{245}{3}$

$\therefore$ Required percentage $= \frac{280}{245} \times 100 = 114.28$

**8. (b)** Required average

$= \frac{80+75+95+85+75+70}{6} = \frac{480}{6} = 80$

**9. (c)** The total number of students who come to school by car

$= \frac{70°}{360°} \times 2160 = 420$

**10. (b)** Required ratio $= 70°:90° = 7:9 = 21:27$

**11. (c)** Required answer $= \frac{80°+90°}{360°} \times 2160 = 1020$

**12. (d)** Required answer $= \frac{360°-120°}{360°} \times 2160 = 1440$

**13. (b)** Required per cent $= \frac{90°-80°}{80°} \times 100 = 12.5\%$

**14. (b)** Required difference = (200 + 195 + 245 + 200 + 225) − (150 + 200 + 250 + 230 + 200) = 1065 − 1030 = 35

**15. (b)** Total number of students playing football = 250 + 125 + 175 + 100 + 250 = 900

Now, from the question,

$\therefore$ $\frac{x \times 900}{100} = 175$ $\therefore$ $x = \frac{175}{9} = 19\frac{4}{9}$

**16. (d)** Total number of players in

School A = 820

School B = 830

School C = 880

School D = 700

School E = 905

**17.** (b) $\frac{130 \times x}{100} = 65 \Rightarrow x = \frac{65 \times 100}{130} = 50$

**18. (c)** Required number of students passed in third division = 165 − 95 = 70

**19. (c)** Percentage of students failed in 1984

$= \frac{35}{200} \times 100 = 17\frac{1}{2}\%$

**20. (c)** Total passed students = 140 + 150 + 165 = 455

Total students = 170 + 195 + 200 = 565

$\therefore$ Required percentage $= \frac{455}{565} \times 100$

$= \frac{9100}{113} = 80\frac{60}{113}\%$

**21. (d)** Required percentage $= \frac{20}{170} \times 100$

$= \frac{200}{17} = 11\frac{13}{17}\%$

**22. (d)** Required percentage $= \frac{140}{170} \times 100$

$= \frac{1400}{17} = 82\frac{6}{17}\%$

**23. (c)** Required answer $= \frac{35 \times 30}{100} + \frac{35 \times 15}{100} + \frac{35 \times 15}{100}$

$= \frac{35}{100}(30+15+15) = \frac{35 \times 60}{100} = 21$ Lakhs

**24. (d)** Percentage variation

Model A $\Rightarrow \frac{40-30}{30} \times 100 = 33\frac{1}{3}$

Model B $\Rightarrow \frac{20-15}{15}\times 100 = 33\frac{1}{3}$

Model C $\Rightarrow \frac{15-20}{20}\times 100 = -25$

**25.** **(a)** Required difference

$= \frac{44\times 20}{100} - \frac{35\times 15}{100}$

$= \frac{880-525}{100} = \frac{355}{100}$ Lakhs $= 355000$

**26.** **(b)** Required production

$= \frac{44\times 30}{100}$ Lakhs

= 1320000

**27.** **(c)** Required answer

$= \left(35\times\frac{10}{100}\times\frac{15}{100} + 44\times\frac{10}{100}\times\frac{15}{100}\right)$ Lakhs

$= \left(\frac{150}{10000}\times 79\right) = 1.1850$ Lakhs

= 118500

**28.** **(c)** Percentage decrease $= \frac{6-5}{6}\times 100$

$= \frac{50}{3} = 16\frac{2}{3}$

**29.** **(b)** Required radio = 2:6 = 1:3

**30.** **(a)** Required average sale

$= ₹\left(\frac{3+4+10+6+6}{5}\right)$crores

$= \left(\frac{29}{5}\right)$ =₹5.8 crores

**31.** **(d)** Required percentage increase $= \frac{10-4}{4}\times 100$ =150%

**32.** **(b)** Required total sales = ₹ (10 + 6 + 6 + 5) crore = ₹27 crores

**33.** **(c)** Average number of students in activity III

$= \frac{65+130+420+75+540+220+153}{7}$

$= \frac{1603}{7} = 229$

Range of number of students in activity IV = 438 − 105 = 333

∴ required difference = 333 − 229 = 104

**34.** **(d)** Total number of students in activity II

= 100 + 200 + 200 + 100 + 100 + 100 + 100 = 900

Total number of students in activity IV

= 317 + 155 + 438 + 105 + 385 + 280 + 120 = 1800

∴ Required percentage $= \frac{900}{1800}\times 100 = 50$

**35.** **(c)** Arranging the observations of activity III in ascending order:

65, 75, 130, 153, 220, 420, 540

Number of observations = 7(odd)

∴ Median $= \left(\frac{7+1}{2}\right)$th observation

= fourth observation = 153

**36.** **(a)** It is obvious from table.

**37.** **(b)** Required ratio = 900:2000 = 9:20

**38.** **(a)** Corresponding angle for rice and barley

$= 72° + 36° = 108°$

∵ $18° = 300$ acres

∴ $1° = \frac{300}{18}$

∴ $108° = \frac{300}{18}\times 108 = 1800$ acres

**39.** **(a)** ∴ $100\% = 360°$

∴ $50\% = 180°$

∴ Wheat + rice + maize $= 72° + 72° + 45° = 189° > 180°$

**40.** **(c)** Required ratio = 72°:36° = 2:1

**41.** **(b)** 10% of 72° = 7.2°

∴ Increase in the corresponding angle of wheat

$= \frac{2}{3}\times 7.2 = 4.8°$

∴ New corresponding angle for wheat = 72° + 4.8° = 76.8°

**42.** **(a)** Let, the production of bajra be $x$ tonnes.

∴ Production of jowar = $2x$ tonnes

⇒ Production of rice = $10x$ tonnes

∴ required ratio $= \frac{10x}{72} : \frac{x}{18} = 5:2$

**43.** **(c)** It is obvious from the table.

**44.** **(d)** Total production of rice = (8 + 10 + 4 + 4 + 2) = 28 Lakhs tonnes

Total production of wheat = (16 + 2 + 4 + 2 + 6) = 30 Lakh tonnes

∴ Required ratio = 28:30 = 14:15

**45.** **(d)** Difference between the production of rice and wheat in

State A ⇒ (16 − 8) = 8 Lakhs tonnes

State B ⇒ (10 − 2) = 8 Lakhs tonnes

**46.** **(b)** State B ⇒ 10 Lakhs tonnes

**47.** **(b)** Average production of rice

$= \left(\frac{8+10+4+4+2}{5}\right) = \frac{28}{5}$ Lakhs tonnes

= 5.6 Lakhs tonnes

**48.** **(a)** Expenditure on housing = 15%
Expenditure on transport = 5%
Difference = 150000 × (15% − 5%)

$$= 150000 \times \frac{10}{100} = ₹15000$$

**49.** **(c)** Maximum expenditure of the family other than on food was on others (20%).

**50.** **(b)** The savings of the family for the year wereequal to the expenditure on housing.

**51.** **(d)** Total Expenditure = 10% + 12% + 5% = 27%

**52.** **(d)** Expenditure on food $= 150000 \times \frac{23}{100} = ₹34500$

**53.** **(b)** Required percentage $= \frac{300}{1200} \times 100\% = 25\%$

**54.** **(d)** Minimum number of persons were killed = 1000 (In 2009)

**55.** **(a)** Maximum number of persons were killed inindustrial accidents = 1200 (in 2006)

**56.** **(b)** Minimum number of persons were killed incoalmines = 150 (in 2007)

**57.** **(c)** Total number of persons were killed
= 1500 + 1050 + 1300 + 1000 = 4850

$\therefore$ Required average $= \frac{4850}{4} = 1212.5$

**58.** **(d)** Perimeter= $2\pi r$ or, $2\pi r = 220$

$$\therefore \quad r = \frac{220 \times 7}{22 \times 2} = 35$$

Angle of the shaded arc $= 360° - 140° = 220°$

Now, area of the sector $= \frac{\theta}{360°} \times \pi \times 35 \times 35$

$$= \frac{220}{360} \times \frac{22}{7} \times 35 \times 35 = \frac{121 \times 175}{9} = \frac{21175}{9}$$

$$= 2352\frac{7}{9} \text{ cm}^2$$

**59.** **(d)** The number of people who watch Arrow in R, Q and T together

$$\left(\frac{50000 \times 10}{100} + \frac{50000 \times 22}{100} + \frac{20000 \times 20}{100}\right.$$

$$\left. + \frac{20000 \times 16}{100} + \frac{50000 \times 12}{100} + \frac{5000 \times 14}{100}\right)$$

= 5000 + 11000 + 4000 + 3200 + 6000 + 7000 = 36200.
The number of people who do not watch Arrow = 34000 + 12800 + 37000 = 83800
$\therefore$ Difference = 83800 − 36200 = 47600
Quicker Method:

Required difference $= 50000 \times \frac{(68-32)}{100} + 20000 + \times \frac{(64-36)}{100} + 50000 \times \frac{(74-26)}{100}$

= 18000 + 5600 + 24000 = 47600

**60.** **(a)** Total number of males who watch Big Bang Theory

$$= 40000 \times \frac{12}{100} + 20000 \times \frac{10}{100} + 50000 \times \frac{18}{100} + 30000 \times \frac{16}{100} + 50000 \times \frac{22}{100})$$

= 4800 + 2000 + 9000 + 4800 + 11000 = 31600

$\therefore$ Average $= \frac{31600}{5} = 6320$

**61.** **(d)** Total number of female population who watches Breaking Bad $= \frac{40000 \times 20}{100} = 8000$

Total number of female population

$$= 40000 \times \frac{3}{8} = 15000$$

Required % $= \frac{8000}{15000} \times 100 = \frac{160}{3} = 53\frac{1}{3}\%$

**62.** **(c)** Total number of people in City R watching Mentalist

$$= \frac{50000 \times 16}{100} + \frac{50000 \times 22}{100} = 8000 + 11000 = 19000$$

Total number of people in City T watching Mentalist

$$= \frac{50000 \times 15}{100} + \frac{50000 \times 20}{100} = 7500 + 10000 = 17500$$

$\therefore$ Required% $= \frac{19000 - 17500}{17500} \times 100$

$$= \frac{1500 \times 100}{17500} = \frac{60}{7} = 8\frac{4}{7}\% \text{ more}$$

**63.** **(b)** Total number of females who watch Breaking Bad in City Q and S together

$$= \frac{20000 \times 10}{100} + \frac{30000 \times 30}{100} = 2000 + 9000 = 11000$$

Total number of female who watch Mentalist in City Q and S together $= \frac{20000 \times 30}{100} + \frac{30000 \times 12}{100}$

= 6000 + 3600 = 9600
$\therefore$ Required ratio = 11000:9600 = 110:96 = 55:48

**64.** **(e)** Average number of male teachers

$$= \frac{40 + 30 + 40 + 70}{4} = \frac{180}{4} = 45$$

Average number of female teachers

$$= \frac{90 + 50 + 70 + 30}{4} = \frac{240}{4} = 60$$

$\therefore$ Difference = 60 − 45 = 15

**65.** **(d)** $GH$=14 cm

$JG = \sqrt{(GH)^2 - (HJ)^2}$, $\sqrt{196-49} = \sqrt{147} = 7\sqrt{3}$ cm

Area of the triangle $GHJ = \frac{1}{2} \times 7\sqrt{3} \times 7 = \frac{49\sqrt{3}}{2}$ cm$^2$

Area of the shaded portion = Area of the triangle $GHJ$ + Area $GLK$

($\because$ $GLK \approx GHJ$)

= 2 × Area of triangle $GHJ$

$= 49\sqrt{3}$ cm$^2$

**66.** **(d)** Total number of novels sold by Store E

$= \frac{10 \times 63000}{100} = 6300$

Total number of Horror novels sold by Store C

$= \frac{63000 \times 20}{100} - \frac{36000 \times 24}{100} = 12600 - 8640 = 3960$

And total number of Horror novels sold by Store F

$= \frac{63000 \times 8}{100} - \frac{36000 \times 12}{100} = 5040 - 4320 = 720$

$\therefore$ Required ratio = 6300:3960 + 720 = 6300:4680 = 630:468 = 35:26

**67.** **(b)** Total number of Horror novels sold by B, C, E and F together

$= \left(\frac{63000 \times 18}{100} - \frac{36000 \times 20}{100}\right) + \left(\frac{63000 \times 10}{100} - \frac{36000 \times 8}{100}\right) + \left(\frac{63000 \times 8}{100} - \frac{36000 \times 12}{100}\right)$

= (630 × 18 − 360 × 20) + (630 × 20 − 360 × 24) + (630 × 10 − 360 × 8) + (630 × 8 − 360 × 12)

= (11340 − 7200) + (12600 − 8640) + (6300 − 2880) + (5040 − 4320)

= 4140 + 3960 + 3420 + 720

= 12240

$\therefore$ Required average $= \frac{12240}{4} = 3060$

**68.** **(d)** Required central angle $= \frac{18}{100} \times 360 = 18 \times 3.6 = 64.8°$

**69.** **(b)** Number of novels sold by Store $F = \frac{63000 \times 8}{100} = 5040$

Number of Romantic novels sold by B and G together

$= \frac{36000 \times (20+10)}{100} = 360 \times 30 = 10800$

$\therefore$ Required% $= \frac{10800 - 5040}{10800} \times 100$

$= \frac{5760 \times 100}{10800} = 53\frac{1}{3}\%$

**70.** **(d)** Total number of Romantic novels sold by Store A, D and G together

$= \frac{18+8+10}{100} \times 36000 = 36 \times 360 = 12960$

Total number of Horror novels sold by Store A, D and G together

$= \left(\frac{15 \times 63000}{100} - \frac{18 \times 36000}{100}\right) + \left(\frac{16 \times 63000}{100} - \frac{8 \times 36000}{100}\right) + \left(\frac{13 \times 63000}{100} - \frac{10 \times 36000}{100}\right)$

= (15 × 630 − 18 × 360) + (16 × 630 − 8 × 360) + (13 × 630 − 10 × 360)

= (9450 − 6480) + (10080 − 2880) + (8190 − 3600)

=2970 + 7200 + 4590 = 14760

$\therefore$ Difference = 14760 − 12960 = 1800

**71.** **(a)** Total number of girls studying IT Engineering from College B, C and D together = 350 + 260 + 325 = 935

Total number of girls studying Electronics Engineering from B, C and D together = 285 + 225 + 255 = 765

$\therefore$ Required% $= \frac{935 - 765}{765} \times 100 = \frac{170}{765} \times 100 = 22\frac{2}{9}$

**72.** **(a)** The number of girls in College C studying Electronics Engineering = 225

Total number of girls in College C = 225 + 260 = 485

$\therefore$ Required % $= \frac{225}{485} \times 100 = 46.39 \approx 46\%$

**73.** **(b)** Total number of flats booked in Aurangabad in 2005

$= \frac{460 \times 110}{100} + \frac{520 \times 120}{100} + \frac{340 \times 115}{100}$

= 506 + 624 + 391 = 1521

**74.** **(b)** Total number of LIG flats booked in Chandigarh = 40

No. of flats booked by the Financial Institution

$= \frac{400 \times 35}{100} = 140$

$\therefore$ Remaining flats = 400 − 140 = 260

Now, number of LIG flats booked by officers from thesoftware company $= \frac{260 \times 6}{13} = 120$

**75.** **(a)** Total number of MIG flats in Mangalore, Baroda and Nagpur = 460 + 240 + 420 = 1120

Total number of LIG flats booked in Mangalore, Baroda and Nagpur=200 + 320 + 300 = 820

$\therefore$ Required% $= \frac{1120 - 820}{820} \times 100 = \frac{300}{820} \times 100$

= 36.58 ≈ 37%

**76.** **(b)** Total number of MIG flats booked in Allahabad,Mangalore, Nagpur and Aurangabad

= 440 + 460 + 420 + 460

= 1780

Total number of LIG flats booked in Allahabad, Mangalore, Nagpur and Aurangabad

= 280 + 200 + 300 + 520

= 1300

$\therefore$ Difference = 1780 − 1300 = 480

**77.** **(a)** Ratio $= \dfrac{440+360+280}{240+420+320} = \dfrac{1080}{980} = \dfrac{108}{98} = 54:49$

**78.** **(a)** Average number of selected employees by Company A

$$= \frac{150+300+300+500+650+800}{6} = \frac{2700}{6} = 450$$

**79.** **(b)** Required ratio = 500:400:550 = 10:8:11

**80.** **(c)** The number of selected employees for Finance Manager by Company C = 250

And the number of selected employees for Finance Manager by Company B = 200

$\therefore$ Required% $= \dfrac{250-200}{200} \times 100 = \dfrac{50}{200} \times 100 = 25\%$

**81.** **(d)** Required average $= \dfrac{800+700+660}{3} = \dfrac{2160}{3} = 720$

**82.** **(a)** Required ratio = 300:200:350 = 30:20:35 = 6:4:7

**83.** **(a)** Total number of students studying Arts in Institutes A and G together

$$= 3800 \times \frac{(15+12)}{100} = 3800 \times \frac{27}{100} = 1026$$

**84.** **(c)** Number of students studying Arts in Institute

$$B = 3800 \times \frac{8}{100} = 304$$

Number of students studying Commerce in Institute

$$B = 4200 \times \frac{17}{100} = 714$$

$\therefore$ Total number of students = 304 + 714 = 1018

**85.** **(b)** Number of students studying Arts in Institute

$$E = 3800 \times \frac{14}{100} = 532$$

Number of students studying Commerce in Institute

$$E = 4200 \times \frac{18}{100} = 756$$

$\therefore$ Required ratio = 532:756 = 19:27

**86.** **(c)** Number of students studying Arts in Institute E = 532

Number of students studying Commerce in Institute

$$D = 4200 \times \frac{14}{100} = 588$$

$\therefore$ Required ratio $= \dfrac{532}{588} = 19:21$

**87.** **(b)** Total number of students studying Commerce in Institutes B and D together

$$= 4200 \times \left(\frac{17+14}{100}\right) = 42 \times 31 = 1302$$

**88.** **(a)** Total marks obtained by Umesh in all subjects together

$$= 50 \times \frac{82}{100} + 50 \times \frac{67}{100} + 150 \times \frac{92}{100} + 100$$

$$\times \frac{87}{100} + 75 \times \frac{69}{100} + 75 \times \frac{76}{100}$$

$= 41 + 33.5 + 138 + 87 + 51.75 + 57$

= 408.25

$\therefore$ Required% $= \dfrac{408.25}{500} \times 100 = 81.65\% \approx 80\%$

**89.** **(b)** Average percentage marks obtained by all the students in Hindi

$$= \frac{88+92+76+83+65+72}{6} = \frac{476}{6} = 79.33\%$$

**90.** **(c)** Average marks obtained by all the students in Mathematics

$$= \frac{150 \times (69+85+92+78+64+88)}{100 \times 6} = \frac{150 \times 476}{600}$$

$$= \frac{476}{4} = 119$$

**91.** **(d)** Average marks obtained by all the students in Geography

$$= \frac{50 \times (85+80+67+72+76+87)}{100 \times 6}$$

$$= \frac{470 \times 50}{600} = \frac{235}{6} = 39.16$$

**92.** **(e)** Total marks obtained by Ritesh in all the subjects together

$$= 50 \times \frac{79}{100} + \frac{50 \times 87}{100} + \frac{88 \times 150}{100} +$$

$$\frac{93 \times 100}{100} + \frac{75 \times 82}{100} + \frac{72 \times 75}{100}$$

$= 34.5 + 43.5 + 132 + 93 + 61.5 + 54$

= 423.5.

**93.** **(a)** Male employees

in Company $A \rightarrow 760 \times \dfrac{13}{19} = 520$

in Company $B \rightarrow 840 \times \dfrac{4}{7} = 480$

in Company $C \rightarrow 720 \times \dfrac{7}{15} = 336$

in Company $D \rightarrow 640 \times \dfrac{9}{20} = 288$

in Company $E \rightarrow 700 \times \dfrac{23}{35} = 460$

$\therefore$ Total number of male employees

= 520 + 480 + 336 + 288 + 460 = 2084

**94.** **(b)** Female employees

in Company $A \rightarrow 760 \times \frac{6}{19} = 240$

in Company $B \rightarrow 840 \times \frac{3}{7} = 360$

in Company $C \rightarrow 720 \times \frac{8}{15} = 384$

in Company $D \rightarrow 640 \times \frac{11}{20} = 352$

in Company $E \rightarrow 700 \times \frac{12}{35} = 240$

$\therefore$ Average $= \frac{240 + 360 + 384 + 352 + 240}{5}$

$= \frac{1576}{5} = 315.2 \approx 315$

**95.** **(c)** Male employees in Companies A and C = 520 + 336 = 856.

Female employees in Companies B and D = 360 + 352 = 712

$\therefore$ Difference = 856 − 712 = 144

**96.** **(d)** Required ratio $= \frac{352}{240} = 22{:}15$

**97.** **(a)** Required percentage

$= \frac{720 - 640}{640} \times 100 = \frac{80}{640} \times 100 = 12.5\%$

***Solutions* (*Q.* 177–181):**

Speed of vehicle A on first day $= \frac{832}{16} = 52$ Km/h

Speed of vehicle A on second day $= \frac{864}{16} = 54$ Km/h

Speed of vehicle B on first day $= \frac{516}{12} = 43$ Km/h

Speed of vehicle B on second day $= \frac{774}{18} = 43$ Km/h

Speed of vehicle C on first day $= \frac{693}{11} = 63$ Km/h

Speed of vehicle C on second day $= \frac{810}{18} = 45$ Km/h

Speed of vehicle D on first day $= \frac{552}{12} = 46$ Km/h

Speed of vehicle D on second day $= \frac{765}{15} = 51$ Km/h

Speed of vehicle E on first day $= \frac{935}{17} = 55$ Km/h

Speed of vehicle E on second day $= \frac{546}{14} = 39$ Km/h

Speed of vehicle F on first day $= \frac{703}{19} = 37$ Km/h

Speed of vehicle F on second day $= \frac{636}{12} = 53$ Km/h

**98.** **(d)** The speed of vehicle B on both the days is 43 Km/h.

**99.** **(c)** Speed of A on first day = 52 Km/h

Speed of C on first day = 63 Km/h

$\therefore$ Difference = 65 − 52 = 11 Km/h

**100.** **(e)** Speed of vehicle C on second day = 45 Km/h

$= 45 \times \frac{5}{18} = 2.5 \times 5 = 12.5$ m/sec

**101.** **(e)** Required percentage $= \frac{636}{703} \times 100 = 90.46 \approx 90\%$

**102.** **(b)** Required Ratio $= \frac{\text{Speed of Vehicle D on day 2}}{\text{Speed of Vehicle E on day 2}}$

$= \frac{51}{39} = \frac{17}{13} = 17:13$

**103.(c)** Total number of mobiles sold in the month of July

$= 45000 \times \frac{17}{100} = 7650$

Mobile phones sold by Company B in the month of July

$= 7650 \times \frac{7}{15} = 3570$

Total numbers of mobile phones sold in the month of December $= 45000 \times \frac{16}{100} = 7200$

Mobile phones sold by Company B in the month of December $= 7200 \times \frac{9}{16} = 4050$

$\therefore$ Required ratio $= \frac{3570}{4050} = \frac{357}{405} = \frac{119}{135} = 119:135$

**104.** **(c)** Number of mobile phones sold in the month of November $= 45000 \times \frac{12}{100} = 5400$

Number of mobile phones sold by Company A in the month of November $= 5400 \times \frac{7}{15} = 2520$

$\therefore$ Number of mobile phones sold without discount in the month of November by Company A

$= 2520 \times \frac{65}{100} = 2520 \times 0.65 = 1638$

**105.** **(d)** Number of mobile phones sold in the month of October $= 45000 \times \frac{8}{100} = 3600$

$\therefore$ Number of mobile phones sold by Company B in the month of October $= 3600 \times \frac{5}{12} = 1500$

$\therefore$ Total profit earned by Company B in the month of October $= 1500 \times 433 = 649500$

**106.** **(e)** Number of mobile phones sold in the month of July

$= 45000 \times \frac{17}{100} = 7650$

Number of mobile phones sold by Company A in the month of July $= 7650 \times \frac{8}{15} = 4080$

Number of mobile phones sold in the month of December

$= 45000 \times \frac{16}{100} = 7200$

Number of mobile phones sold by Company A in the month of December $= 7200 \times \frac{7}{16} = 3150$

$\therefore$ Required% $= \frac{4080}{3150} \times 100 = 129.52 \approx 130$

**107. (a)** Number of mobile phones sold in the month of August

$= \frac{22}{100} \times 45000 = 9900$

Number of mobile phones sold in the month of September

$= \frac{25}{100} \times 45000 = \frac{1}{4} \times 45000 = 11250$

Number of mobile phones sold by Company B in the month of August $= 9900 \times \frac{5}{9} = 5500$

Number of mobile phones sold by Company B in September

$= 11250 \times \frac{2}{5} = 4500$

Total number of mobile phones sold in August and September by Company B = 5500 + 4500 = 10000

**Quicker Method:**

Total number of mobile phones sold by Company B in August and September

$= \left(\frac{22}{100} \times 45000 \times \frac{5}{9} + \frac{25}{100} \times 4500 \times \frac{2}{5}\right) = 10000$

**108. (d)** Production of Company A in the year 2009 = 550

Production of Company A in year the 2010 = 700

Required% $= \frac{700 - 550}{550} \times 100 = \frac{150}{550} \times 100$

$= \frac{300}{11} = 27.27 \approx 27\%$

**109. (b)** Sales of Company A in the year 2009 = 400

Production of Company A in the year 2009 = 550

Required% $= \frac{400}{550} \times 100 = \frac{800}{11} = 72.72 \approx 73\%$

**110. (c)** Average production of Company B

$= \frac{600 + 700 + 800 + 600 + 650 + 700}{6}$

$= \frac{4050}{6} = 675$

**111. (e)** Required ratio $= \frac{\text{Total Production of Company A}}{\text{Total Sales of Company A}}$

$= \frac{4050}{2750} = \frac{81}{55} = 81{:}55$

**112. (c)** Production of Company B in the year 2006 = 150 × 4 = 600

Production of Company *B* in the year 2008 = 200 × 4 = 800

Ratio $= \frac{600}{800} = 3{:}4$

**113. (e)** Number of men visiting supermarket *D*

= 41% of 55500

$= \frac{41 \times 55500}{100} = 41 \times 555 = 22755$

Total number of people visiting all the supermarkets together

= 34560 + 65900 + 45640 + 55500 + 42350 + 59650

= 303600

$\therefore$ Required percentage $= \frac{22755}{303600} \times 100$

= 7.5% (Approx).

**114. (d)** Number of children visiting supermarket *C*

$= 20\%$ of $45640 = \frac{20 \times 45640}{100} = 9128$

Number of children visiting supermarket *F*

$= 14\%$ of $59650 = \frac{14 \times 59650}{100} = 8351$

$\therefore$ Required percentage $= \frac{9128}{8351} \times 100 = 109.30\%$

**115. (c)** Total number of children visiting supermarket *B* and *D* together

= 20% of 65900 + 33% of 55500

$= \frac{20 \times 65900}{100} + \frac{33 \times 55500}{100}$

= 13180 + 18315 = 31495

**116. (a)** Total number of women

= 55% of 34560 + 43% of 65900 + 45% of 45640 + 26% of 55500 + 70% of 42350 + 62% of 59650

= 19008 + 28337 + 20538 + 14430 + 29645 + 36983

= 148941

$\therefore$ Required average $= \frac{148941}{6} = 24823.5$

**117. (e)** Required ratio = 19008:20538 = 1056:1141

**118. (c)** Difference of corresponding angles

= (122.4 + 21.6)° − (79.2 + 14.4)° = 50.4°

$\therefore$ Required difference $= \frac{50.4}{360} \times 6800 = 952$

**119.** **(a)** Required Ratio = 21.6:79.2 = 3:11

**120.** **(d)** Required percentage $=\left(\dfrac{64.8+21.6}{360}\right)\times 100 = 24\%$

**121.** **(b)** Required percentage $=\dfrac{14.4}{122.4}\times 100 = 11.76 \approx 12\%$

**122.** **(a)** Number of students who prefer beverages $B$ and $E$ together

$$=\left(\frac{57.6+64.8}{360}\right)\times 6800 = \frac{122.4\times 6800}{360} = 2312$$

**123.** **(b)** Total marks of Anuska

$$=\frac{150\times 66}{100}+75+\frac{150\times 88}{100}+\frac{56\times 125}{100}+\frac{56\times 75}{100}+45$$

= 99 + 75 + 132 + 70 + 42 + 45 = 463

**124.** **(c)** Marks obtained by Garvita in Brand Management = 88% of 100 = 88

Marks obtained by Archita in Brand Management = 76% of 100 = 76

$\therefore$ Required percentage $=\dfrac{88}{76}\times 100 \approx 115.79\%$

**125.** **(a)** Average marks obtained by all the students together in Compensation Management

$$=\frac{\begin{pmatrix}\text{Total percentage of marks}\\ \text{obtained by all the students}\\ \text{in Compensation Management}\end{pmatrix}\times\begin{pmatrix}\text{Maximum marks in}\\ \text{Compensation}\\ \text{Management}\end{pmatrix}}{100\times \text{Total number of students}}$$

$$=\left(\frac{88+84+78+96+68+50}{6\times 100}\times 150\right)$$

$$=\frac{464}{600}\times 150 = 116$$

**126.** **(d)** Total marks obtained in all subjects together by

**Arpan:** 76% of 150 + 66% of 100 + 78% 0f 150 + 88% of 125 + 72% of 75 + 70% of 50

$$=\frac{76\times 150}{100}+\frac{66\times 100}{100}+\frac{78\times 150}{100}+\frac{88\times 125}{100}+\frac{72\times 75}{100}+\frac{70\times 50}{100}$$

= 114 + 66 + 117 + 110 + 54 + 35 =496

**Archit:** 82% of 150 + 76% of 100 + 84% of 150 + 96% of 125 + 92% of 75 + 88% of 50

$$=\frac{82\times 150}{100}+\frac{76\times 100}{100}+\frac{84\times 150}{100}+\frac{96\times 125}{100}+\frac{92\times 75}{100}+\frac{88\times 50}{100}$$

= 123 + 76 + 126 + 120 + 69 + 44 = 558

**Garvita:** 90% of 150 + 88% of 100 + 96% of 150 + 76% of 125 + 84% of 75 + 86% of 50

$$=\frac{90\times 150}{100}+\frac{88\times 100}{100}+\frac{96\times 150}{100}+\frac{76\times 125}{100}+\frac{84\times 75}{100}+\frac{86\times 50}{100}$$

= 135 + 88 + 144 + 95 + 63 + 43 = 568

**Gunit:** 64% of 150 + 70% of 100 + 68% of 150 + 72% of 125 + 68% of 75 + 74% of 50

$$=\frac{64\times 150}{100}+\frac{75\times 100}{100}+\frac{68\times 150}{100}+\frac{72\times 125}{100}+\frac{68\times 75}{100}+\frac{74\times 50}{100}$$

= 96 + 70 + 102 + 90 + 51 + 37 = 446

**Pranita:** 48% of 150 + 56% of 100 + 50% of 150 + 64% of 125 + 64% of 75 + 58% of 50

$$=\frac{48\times 150}{100}+\frac{56\times 100}{100}+\frac{50\times 150}{100}+\frac{64\times 125}{100}+\frac{64\times 75}{100}+\frac{58\times 50}{100}$$

= 72 + 56 + 75 + 80 + 48 + 29 = 360

Clearly, Garvita scored the highest total marks in all the subjects together.

**Quicker approach:** If you look at the table carefully and compare the percentage marks obtained in all the subjects by Arpan, Gunit and Pranita from the percentage marks obtained in the respective subjects by Archita and Garvita, we find that these students (Arpit, Gunit and Pranita) obtained less percentage marks than the percentage marks obtained by Archit and Garvita. Therefore, now we need to calculate total marks of Archit and Garvita only. In such a way we may save a few precious minutes.

**127.** **(b)** Archit (consumer behaviour and service marketing) and Garvita (strategic management, brand management and compensation management).

**128.** **(d)** Number of students who opted for all three subjects in 2009

= (20 + 20 + 5) thousand = 45000

Number of boys $=\dfrac{45000\times 62}{100} = 27900$

Since, we don't know the number of girls in Mathematics, Number of boys opted for Mathematics cannot be determined.

**129.** **(b)** Required percentage $=\dfrac{(15+10+15)\times 1000}{455030}\times 100$

$$=\frac{40000}{455030}\times 100 \approx 9$$

**130.** **(e)** Required number of students

= (5 + 35 + 15 + 15 + 20 + 5) × 1000

= 95 × 1000 = 95000

**131.** **(d)** Required percentage

$$=\left[\frac{(15+30)\times 1000}{\{(5+35+15)+(25+30+30)\}\times 1000}\right]\times 100$$

$$=\left(\frac{(15+30)}{(55+85)}\right)\times 100 = \frac{45}{100}\times 100 \approx 32$$

**132.** **(a)** Required ratio = (25 + 30):(5 + 20) = 55:25 = 11:5

**133.** **(b)** Profit earned by Company $B$ in 2006 is 65% of investment or 812500.

$\therefore$ Income $= \dfrac{812500}{65} \times 165 = 2062500$

**134.** **(c)** Let, the amount invested by Companies $A$ and $B$ in the year 2005 be ₹$x$ each.

Income of $A$ in 2005 = $1.70x$

Income of $B$ in 2005 = $1.55x$

Ratio $= \dfrac{A}{B} = \dfrac{1.70x}{1.55x} = \dfrac{34}{31}$

**135.** **(b)** Amount invested by Company $B$ in 2009

$= \dfrac{1}{3} \times 27 \times 10^5 = 9$ Lakhs

Amount invested by Company $A$ in 2009

$= \dfrac{2}{3} \times 27 \times 10^5 = 18$ Lakhs

Profit earned by Company $B$

$= \dfrac{80}{100} \times 9 \times 10^5 = 72 \times 10^4$

Profit earned by company $A$

$= \dfrac{75}{100} \times 18 = 13.5$ Lakhs

Total profit = 13.5 + 7.2 = 20.7 Lakhs

**136.** **(a)** Income of $A$ in 2007 $= \dfrac{145}{100} \times 12 \times 10^5 = 174 \times 10^4$

Amount invested in 2008 $= \dfrac{174 \times 10^4}{160} \times 100 = 1087500$

**137.** **(e)** Let, total investment be ₹$x$.

Now, 55% of $x = 10.15 \times 10^5$

$\Rightarrow \quad x = \dfrac{10.15 \times 10^5}{55} \times 100 = 1845454$

**138.** **(c)** Income of Company $B$ in 2004

$= 1.55 \times 12 \times 10^5 = 18.6$ Lakhs.

Investment in 2005 = 18.6 Lakhs

Profit earned in 2005 $= \dfrac{55}{100} \times 18.6 \times 10^5 = 10.23$ Lakhs

**139.** **(a)** Investment of Company $A$ in 2008 $= \dfrac{24 \times 10^5}{1.60}$ = 15 Lakhs

Profit in 2008 = 24 − 15 = 9 Lakhs

Profit in 2007 $= \dfrac{45}{100} \times 15 \times 10^5 = 6.75$ Lakhs

Required answer = 9 − 6.75 = 2.25 Lakhs

**140.** **(d)** Required answer $= \dfrac{\dfrac{90}{100} \times 25 \times 10^5 + \dfrac{70}{100} \times 25 \times 10^5}{2}$

$= \dfrac{25 \times 10^5}{100}\left[\dfrac{90+70}{2}\right]$

$= 25 \times 10^3 \times 80 = 20$ Lakhs

**142.** **(e)** Required average

$= \dfrac{5200 + 8400 + 7600 + 2600 + 3800 + 4400 + 6000}{7}$

$= \dfrac{38000}{7} = 5428.5 \approx 5500$

**143.** **(d)** Number of candidates eligible for post I

= 100(25 + 32 + 28 + 24 + 30 + 48 + 65)

= 25200

Number of candidates shortlisted for post I

= 65 + 220 + 280 + 85 + 120 + 325 + 550

= 1645

$\therefore$ Required answer $= \dfrac{1645}{25200} \times 100 = 6.52\%$

**144.** **(a)** Number of candidates shortlisted from state $E$ for all the posts = 120 + 280 + 75 + 280 + 260 + 520 = 1535

Number of candidates shortlisted form state $G$ for all posts = 550 + 140 + 325 + 220 + 410 + 200 = 1845

Required answer $= \dfrac{1535}{1845} = \dfrac{307}{369}$

**145.** **(e)** Total number of candidates eligible from all states for post I = 25200

Total number of candidates eligible from all states for post VI = 39400

Required answer $= \dfrac{25200}{39400} \times 100 = 63.9\%$

**147.** **(c)** Total candidates shortlisted for post V = 1650

Total candidates shortlisted for post VI = 2780

Required ratio $= \dfrac{1650}{2780} = \dfrac{165}{278}$

| | English | Hindi | Both | Total |
|---|---|---|---|---|
| Boys | 24 | 18 | 108 | 150 |
| Girls | 55 | 78 | 117 | 250 |
| Total | 79 | 96 | 225 | 400 |

**148.** **(b)** 18 + 108 = 126

**150.** **(a)** 79 + 225 = 304

**151.** **(e)** $\dfrac{78}{96} \times 100 = 81.25\%$

**152.** **(c)** Ratio $= \dfrac{108}{117} = \dfrac{12}{13}$

**153.** **(c)** Area of the circle = $\pi r^2$ = 616

$\Rightarrow \quad r^2 = 196$

$\Rightarrow \quad r = 14$ cm

Length of the rectangle = Diameter of the circle.

Breadth of the rectangle = Radius of the circle

Area of the rectangle = 28 × 14 = 392 $cm^2$

**154.** **(a)** The total population of all cities = 85 million
Total males in all cities = 43.4 million
Total females = 85 − 43.4 = 41.6 million
Average female population $=\frac{41.6}{5}=8.32$ million

**155.** **(b)** $\frac{(1300-1100)}{1100}\times 100=18.18\%$

**156.** **(d)** $\frac{72}{100}\times 550=396$

**157.** **(d)** Required percentage $=\frac{(9-8)\times 100}{8}=12.5\%$

**158.** **(a)** Students enrolled in 2008 in all three districts = 8000 + 6000 + 7000 = 21000
Students enrolled in district *B* over all the years together = 5000 + 4000 + 7000 + 6000 + 4000 + 7000 = 33000
Difference = 33000 − 21000 = 12000

**159.** **(b)** Required average $=\frac{1000(3+5+6+8+7+5)}{6}$

$=\frac{1000\times 34}{6}=5666$

**160.** **(c)** Total number of students:

| Year | Number of students (in thousand) |
|---|---|
| 2005 | 14 |
| 2006 | 17 |
| 2007 | 22 |
| 2008 | 21 |
| 2009 | 16 |
| 2010 | 18 |

**161.** **(a)** Required percentage $=\frac{(5+7)}{8}\times 100=150\%$

**162.** **(b)** Difference between the appeared candidates and qualified candidates in the zone *S*:

| Year | Difference |
|---|---|
| 2005 | (4.2 − 2.4) × 100 = 180 |
| 2006 | (7.4 − 3.3) × 100 = 410 |
| 2007 | (8.3 − 5.6) × 100 = 270 |
| 2010 | (14.2 − 11.4) × 100 = 280 |

**163.** **(e)** Required percentage $=\frac{7.4}{5.4}\times 100=137\%$

**164.** **(d)** Required average

$=\frac{100(6.2+6.2+6.4+7.8+9.9+11.8)}{6}=805$

**165.** **(a)** Required ratio $=\frac{3.2}{5.6}=\frac{4}{7}$

**166.** **(e)** Number of candidates qualified in the years 2009 and 2010 together:
Zone *S*: (11.4 + 5.2) × 100 = 16.6 × 100 = 1660
Zone *T*:: (6.9 + 9.4) × 100 = 16.3 × 100 = 1630

**167.** **(a)** Average number of passengers travelling in trains *A*, *C* and *F*

$=\left(\frac{12+17+22}{3}\right)\%$ of 4800

$=17\%$ of $4800=\frac{17}{100}\times 4800=816$

**168.** **(b)** Total amount paid by passengers of train *B*

$=124\times\frac{9}{100}\times 4800=$ ₹53568

**169.** **(a)** Required percentage $=\frac{19}{9+21}\times 100=63.33\%\approx 63\%$

**170.** **(e)** Required difference = (17 − 12)% of 4800 = 5% of 4800

$=\frac{5}{100}\times 4800=240$

**171.** **(c)** Required number of passengers
= (21 + 19 + 22)% of 4800 = 62% of 4800

$=\frac{62}{100}\times 4800=2976$

**172.** **(c)** Required percentage increase $=\frac{(13.9-11.6)}{11.6}\times 100$

$=\frac{2.3}{11.6}\times 100=19.82\%\approx 20\%$

**173.** **(b)** Required average fee

$=\frac{1000(5.8+6.4+10.2+14.6+17.7+20.9)}{6}$

$=\frac{1000\times 75.6}{6}=12600$

**174.** **(d)** Total fees of diploma over all the years
= 1000 (1.8 + 3.2 + 4.8 + 5.6 + 12.5 + 14.9)
=42800
Fees of BTech for 2009 = 35800
Difference = 42800 − 35800 = 7000

**175.** **(e)** Required percentage $=\frac{12.7}{17.7}\times 100=71.75\%\approx 72\%$

**176.** **(b)** Total fee charged in the year 2006
= 1000(14.5 + 6.4 + 11.6 + 5.8 + 3.2)
= 1000 × 41.5 = 41500

**177.** **(d)** Number of girls in

School $C$: $\frac{6000\times 26}{100}-900=1560-900=660$

School $E$ $\frac{6000\times 29}{100}-1200=1740-1200=540$

$\therefore$ Required answer = 660 + 540 + 600 = 1800

**178.** **(c)** Number of girls in school $B=\frac{6000\times 9}{100}-400$ = 540 − 400 = 140

Number of students in school $E=\frac{6000\times 29}{100}=1740$

$\therefore$ Required ratio = 900:140:1740 = 45:7:87

**179.** **(e)** Required difference $=1200-\frac{6000\times 6}{100}$ = 1200 − 360 = 840

**180.** **(b)** Number of students in school $B=\frac{6000\times 9}{100}=540$ = Number of girls in School E

**181.** **(e)** Number of girls in school A

$=\frac{6000\times 12}{100}-500=720-500=220$

$\therefore$ Required percentage $=\frac{220}{540}\times 100=41$

**182.** **(e)** Required percentage

$=\frac{34}{(15+19+24+21+34+27}\times 100$

$=\frac{34}{140}\times 100\approx 24$

**183.** **(e)** Required difference = (27 − 21) × $10^3$ = 6000

**184.** **(d)** Required average

$=\left(\frac{35+21+19+32+26+20}{6}\right)\times 10^3$

$=\frac{153}{6}\times 10^3=25500$

**185.** **(a)** Required percentage $=\frac{34}{20}\times 100=170\%$

**186.** **(a)**

| Mumbai | Delhi | Kolkata | Chennai | Hyderabad | Lucknow |
|---|---|---|---|---|---|
| 114 | 101 | 113 | 133 | 127 | 123 |

**187.** **(d)** Number of boys in schools R and U together

$=\frac{(2000\times 72.5+1000\times 82.5)}{100}=1450+825=2275$

Required percentage $=\frac{2275}{3000}\times 100=75.83\%$

**188.** **(c)** Number of boys in school $T=\frac{1250\times 60}{100}=750$

**189.** **(a)** Required percentage

$=\frac{2000}{2250}\times 100\approx 89\%$

**190.** **(b)** Required average

$=\frac{1}{2}\left(\frac{2500\times 60}{100}+\frac{3000\times 55}{100}\right)=\frac{1}{2}(1500+1650)$

$=\frac{1}{2}\times 3150=1575$

**191.** **(c)** Required ratio

$=2500\times\frac{40}{100}:3000\times\frac{45}{100}$

= 25 × 40:30 × 45 = 20:27

**192.** **(c)** Average marks obtained by F

$=\frac{\left(74\times\frac{75}{100}+68\times\frac{80}{100}+42\times\frac{125}{100}\right)}{3}$

$=\frac{(129.5+54.4+52.5)}{3}=\frac{236.4}{3}=78.8$

**193.** **(d)** Average marks obtained by all students in Science

$=\frac{(91+87+81+70+49+42)}{6}\times\frac{125}{100}$

$=\frac{49\times\frac{5}{4}}{6}=\frac{525}{6}=87.5$

**194.** **(b)** Percentage

$=\frac{6.0-5.1}{5.1}\times 100=\frac{9}{51}\times 100=\frac{300}{17}=17.6\approx 18$

**195.** **(a)** Average production

$=\frac{(4.9+3.7+4.7+4.3+3.1+3.9)}{6}$

$=\frac{24.6}{6}=4.1$ tonnes

**196.** **(d)** Total sugar produced in 2006 = 17.5 tonnes
Total sugar produced in 2007 = 20 tonnes
Required ratio = 17.5:20 = 7:8

**197.** **(d)** Average production of $R$ for all the years together

$=\frac{36.6}{6}=6.1$ tonnes

**198.** **(c)** Required difference
= (7.4 − 5.6) + (6.2 − 4.4) + (8.3 − 5.8)
= 1.8 + 1.8 + 2.5 = 6.1 tonnes

**199.** **(e)** Ratio of the expenditure made by the university on research work and that on purchase of books for library
= (8% of 60 Lakhs):(6% of 60 Lakhs)
= 8:6 = 4:3

**200. (b)** Required expenditure
= (8 + 24 + 6)% of 60 Lakhs

$$= 38 \times \frac{60}{100} \text{ Lakhs} = 22.8 \text{ Lakhs}$$

**201. (b)** Required difference = (15 – 10)% of 60 Lakhs

$$= \frac{5 \times 60}{100} \text{ Lakhs} = 3 \text{ Lakhs}$$

**202. (b)** Expenditure before decrease = 24% of 60 Lakhs = ₹14.4 Lakhs

Decrease in expenditure = 7% of 14.4 Lakhs = ₹1.008 Lakhs

Present expenditure = ₹(14.4 – 1.008) Lakhs = ₹13,39,200

**204. (c)** Percentage rise in number of students from college A in 2004

$$= \frac{40 - 20}{20} \times 100 = 100\%$$

Similarly, percentage rise in number of students from college B in 2004

$$= \frac{60 - 30}{30} \times 100 = 100\%$$

**205. (d)** Number of students in college A in the years 2004, 2006 and 2007 = 160 × $10^3$

Also, number of students in college B in the year 2003, 2004 and 2008 = 175 × $10^3$

Required ratio = 160:175 = 32:35

**208. (c)** $\text{Required\%} = \frac{85}{390} \times 100 = 21.79\%$

**209. (e)** Number of products manufactured in 2009 = (52.5) × $10^3$

Number of products manufactured in 2008 = (47.5) × $10^3$

Required difference = (52.5 – 47.5) × $10^3$ = 5000

**210. (a)** Required percentage $= \frac{25}{35} \times 100 = 71.43\%$

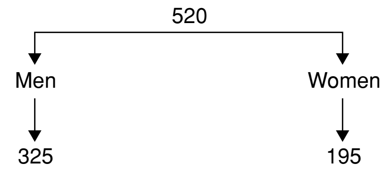
**211. (b)** Required percentage $= \left(\frac{40 - 30}{30}\right) \times 100 = 33.33\%$

**212. (c)** Required ratio = (45 – 42.5):(37.5 – 30) = 2.5:7.5 = 1:3

**213. (d)** Required average

$$= \frac{(35 + 37.5 + 42.5 + 45 + 47.5 + 52.5)}{6}$$

$$= \frac{260}{6} \times 10^3 = 43330$$




| HR | IT | Production | Marketing |
|---|---|---|---|
| 13 | 65 | 130 | 117 |
| 78 | 78 | 5 | 34 |

**214. (a)** Required percentage $= \frac{117}{520} \times 100 = 22.5\%$

**215. (e)** Required ratio = 13:78 = 1:6

**217. (d)** Required percentage $= \frac{135}{520} \times 100 = 25.96 \approx 26\%$

**219. (e)** Total executives recruited were 2953.

**220. (d)** Required ratio = 1044:998 = 522:499

**221. (a)** Required average number of executives

$$= \frac{2965}{6} \approx 494$$

**222. (b)** Required percentage increase

$$= \frac{54}{418} \times 100 = 12.919 \approx 12.92\%$$

**223 (c)** Required percentage $= \frac{510}{2854} \times 100 \approx 18\%$

**224. (c)** Required ratio = 475:425 = 19:17

**225. (d)** Total distance covered by all the trucks = 2375 Km

Average distance covered by all the trucks

$$= \frac{2375}{5} = 475$$

**226. (b)** Total distance covered by A = 475 Km

Time taken $= \frac{475}{47.5} = 10$ hours

**227. (d)** Total distance covered by E = 575 Km

Total distance covered by B and C together
= 350 + 550 = 900 Km

Required percentage $= \frac{575}{900} \times 100 \approx 64\% \approx 62\%$

**228. (d)** Required speed $= \frac{550}{8} = 68.75 \text{ Km/h}$

**229. (c)** Analysing the table we find three villages L, O and Q for which the number of children can be the least.

| Village | *L* | *O* | *Q* |
|---|---|---|---|
| No. of children | 248 | 252 | 199 |

**230. (d)** Required ratio

$$=\left(1240\times\frac{45}{100}+2060\times\frac{40}{100}\right):\left(1240\times\frac{45}{100}+2060\times\frac{40}{100}\right)$$

= (558 + 824):(434 + 824)

= 1382:1258 = 691:629

**231. (e)** Total number of children and women in village Q = 60% of 1990 = 1194.

**232. (a)** Required percentage $=\frac{1680}{10560}\times 100 \approx 16\%$ .

**233. (b)** Required number

$$= 2140\times\frac{1}{4}+1450\times\frac{1}{5}=535+290=825$$

# Data Sufficiency

# 40

## INTRODUCTION

*Data sufficiency* problems as the name suggests test the ability of the students to judge whether the data given in the form of statements is sufficient to answer the question asked. There is no need to solve the problem. All you need to determine is whether it would be possible to answer the question. As soon as you can tell that an answer would be obtainable, you can stop working.

In each of these problems, a question is asked followed by two or three statements. You have to study the question and all the statements given and decide whether any information provided in the statement (s) is/are redundant and can be dispensed with while answering the questions. You have to decide whether the question can be answered with anyone or two of the statements or all the three statements are required to answer the question. The answer number bearing the combination of statements or, single statement which is necessary to answer the question is your answer.

**Illustration 1**: What is the perimeter of a rectangular garden?

A. The area of the garden is 2400 $m^2$.
B. The diagonal of the garden is 50 m.
C. The ratio between the length and the breadth of the garden is 3:2.

(a) All $A$, $B$ and $C$ together are required
(b) Any two of $A$, $B$ and $C$ are sufficient
(c) Only A and $B$ are required
(d) Only $B$ and $C$ are required
(e) None of these

**Solution**: **(b)** Let the length and breadth of rectangle be $l$ and $b$, respectively.

$$A \rightarrow l \times b = 2400.$$

$$B \rightarrow l^2 + b^2 = 2500$$

$$C \rightarrow l = \frac{3}{2}b.$$

Solving any two of the above equations, we get the values of $l$ and $b$.

**Illustration 2**: Two friends Anu and Manu earned profit in a business. Find out their shares.

A. Anu had invested her capital for 9 months and Manu for 1 year
B. The ratio of their capitals was 4:3
C. The total profit was ₹27500

(a) Only $B$ and $C$ together are sufficient
(c) All together are necessary
(d) Either $B$ or $A$ and $C$ together are sufficient
(e) All even together are not sufficient

**Solution**: **(c)** From (A) and (B), we have

Ratio of profits = 9 × 4:12 × 3 = 36:36 = 1:1.

Now, with the help of (C), share of each of them

$$= \frac{27500}{1+1} \times 1 = ₹13750$$

## EXERCISE-I

**Directions (1–50)**: Each of the questions below consists of a question and two statements numbered I and II given below it. You have to decide whether the data provided in the statements are sufficient to answer the question. Read both the statements and...

**Give answer (a)** If the data in statement I alone are sufficient to answer the question, while the data in statement I alone are not sufficient to answer the question.

**Give answer (b)** If the data in statement II alone are sufficient to answer the question, while the data in statement I alone are not sufficient to answer the question.

**Give answer (c)** If the data either in statement I alone or in statement II alone are sufficient to answer the question.

**Give answer (d)** If the data even in both statements I and II together are not sufficient to answer the question.

**1.** What will be the cost of the second necklace?

I. The cost of the first necklace is $\frac{1}{5}$ more than the second and the cost of the third necklace is $\frac{2}{5}$ more than the second. The total cost of all the three necklaces is ₹120000.

II. The cost of the first necklace is $\frac{2}{5}$ more than the second. The cost of the third necklace is the least and total cost of all the three necklaces is ₹120000.

**2.** How many items did the distributor purchase?

I. The distributor purchased all the items for ₹4500.

II. If the distributor had given ₹5 more for each item he would have purchased 10 items less.

**3.** How long will it take to fill a tank?

I. One pipe can fill the tank completely in 3 hrs.

II. Second pipe can empty that tank in 2 hrs.

**4.** What will be the area of a plot in sq. metres?

I. The length of that plot is 113 times the breadth of that plot.

II. The diagonal of that plot is 30 metres.

**5.** How much minimum marks will be required to pass an examination?

I. Student *A* secured 32% marks in that examination and he failed by 1 mark. Student *B* secured 36% marks in the same examination and his marks were 1 more than the minimum pass marks.

II. Student *A* secured 30% of full marks in the examination and he failed by 2 marks. If he had secured 5 more marks his percentage of marks would have been 40%.

**6.** What will be the cost of painting of the inner wall of a room if the rate of painting is ₹20 per.$m^2$?

I. Perimeter of the floor is 44 feet.

II. Height of the wall of the room is 12 feet.

**7.** What is the ratio of the number of boys and girls in a school?

I. Number of boys is 40 more than the girls.

II. Number of girls is 80 percent of the number of boys.

**8.** What is the difference between two numbers?

I. First number is 60 percent of the other number.

II. 50 percent of the sum of first and second numbers is 24.

**9.** What was the speed of the running train?

I. Length of the train was 120 m.

II. The train crossed the other train whose length was 180 m in 4 sec.

**10.** What will be the compound interest after 3 years ?

I. Rate of interest is 5 percent.

II. The difference between the total simple interest and the total compound interest after two years is ₹20.

**11.** How many boys are there in the class?

I. The class has total 45 children and ratio of boys to girls is 4:5.

II. The ratio of girls to boys is 4:5 and boys are nine more than the girls.

**12.** What is the average monthly income per family member?

I. Each male earns ₹1250 a month and each female earns ₹1050 a month.

II. Ratio of males to females in the family is 2:1.

**13.** What is the value of $m - n \div 37$?

I. $m$ is the largest possible six-digit number and $n$ is the smallest possible six-digit number.
II. The difference between $m$ and $n$ is known.

**14.** What selling price should be marked on the article?

I. Discount of 5% is to be given and profit percentage should be double the discount. Purchase cost is in the range of ₹300 ₹400.
II. 10% discount is to be allowed and 15% profit is to be obtained on the purchase cost of ₹200 of the article.

**15.** What is the cost of polishing the rectangular floor?

I. Room is 9 m long and 7 m wide.
II. Cost of polishing the floor of 10 m by 5 m is ₹112.50.

**16.** How many marks did Prakash obtain in Mathematics?

I. Prakash secured on an average 55 percent marks in Mathematics, Physics and Chemistry together.
II. Prakash secured 10 percent more than the average in Mathematics.

**17.** What is the rate of compound interest on a sum of money?

I. The total compound interest at the end of two years is ₹820.
II. The total simple interest at the same rate on ₹5000 at the end of three years is ₹750.

**18.** Which is the smaller of the two numbers?

I. The difference between these two numbers is one-third of the largest number.
II. The sum of these two numbers is 30.

**19.** What is the height of a right-angled triangle?

I. The area of the right-angled triangle is equal to the area of a rectangle whose breadth is 12 cm.
II. The length of the rectangle is 18 cm.

**20.** What is the speed of a running train which takes 9 seconds to cross a signal post?

I. The length of the train is 90 m.
II. The train takes 27 seconds to cross a platform of 180 m.

**21.** What was the ratio between the ages of $P$ and $Q$ four years ago?

I. The ratio between the present ages of $P$ and $Q$ is 3:4.
II. The ratio between the present ages of $Q$ and $R$ is 4:5.

**22.** What was the cost price of the suitcase purchased by Samir?

I. Samir got 20 percent concession on the labeled price.
II. Samir sold the suitcase for ₹2000 with 25 percent profit on the labeled price.

**23.** What is the height of a triangle?

I. The area of the triangle is 20 times its base.
II. The perimeter of the triangle is equal to the perimeter of a square of 10 cm side.

**24.** What percentage rate of simple interest per annum did Ashok pay to Sudhir?

I. Ashok borrowed ₹8000 from Sudhir for four years .
II. Ashok returned ₹8800 to Sudhir at the end of two years and settled the loan.

**25.** What is the speed of a running train?

I. The train crosses a signal post in 6 seconds.
II. The train crosses another train running in the opposite direction in 15 seconds.

**26.** Train '$A$' running at a certain speed crosses another train '$B$' running at a certain speed in the opposite direction in 12 seconds. What is the length of train '$B$'?

I. The length of both the trains together is 450 m.
II. Train '$A$' is slower than train '$B$'.

**27.** The area of a rectangle is equal to the area of a right-angled triangle. What is the length of the rectangle?

I. The base of the triangle is 40 cm.
II. The height of the triangle is 50 cm.

**28.** What was the total compound interest on a sum after three years ?

I. The interest after one year was ₹100 and the sum was ₹1000.
II. The difference between simple and compound interest on a sum of ₹1000 at the end of two years was ₹10.

**29.** What is the two-digit number where the digit at the unit's place is smaller?

I. The difference between the digits is 5.
II. The sum of the two digits is 7.

**30.** What is the speed of the boat in still water?

I. It takes 2 hours to cover the distance between $A$ and $B$ downstream.
II. It takes 4 hours to cover the distance between $A$ and $B$ upstream.

**31.** What is the rate of simple interest per annum?

I. The sum triples in 20 years at simple interest.
II. The difference between the sum and the simple interest earned after 10 years is ₹1000.

**32.** What is the sum which earned interest?

I. The total simple interest was ₹7000 after 7 years.
II. The total of sum and simple interest was double of the sum after 5 years .

**33.** A train crosses a signal post in $X$ sec. What is the length of the train?

I. The train crosses a platform of 100 m in $Y$ sec.
II. The train is running at the speed of 80 Km/h.

**34.** What is the area of a circle?

I. The circumference of the circle is 308 m,
II. The radius of the circle is 28 m.

**35.** $A$, $B$ and C are integers. Is $B$ an even number?

I. $(A + B)$ is an odd number.
II. $(C + B)$ is an odd number,

**36.** How many children are there in the class?

I. Numbers of boys and girls are in the respective ratio of 3:4.
II. Number of girls is more than the number of boys by 18.

**37.** What was the population of State '$A$' in 1999?

I. Population of the State increases every year by 20% and its population in 1997 was 120000.
II. Population of State $A$ in 1997 was twice that of State $B$ in the same year.

**38.** What is the cost of laying carpet in a rectangular hall?

I. Cost of the carpet is ₹450 per $m^2$,
II. Perimeter of the hall is 50 metre.

**39.** What is the rate of interest p.c.p.a.?

I. Difference between compound interest and simple interest on an amount or ₹10,000 for two years is ₹225.
II. The amount doubles itself on simple interest in $6\frac{2}{3}$ years.

**40.** What is a two-digit number?

I. The number obtained by interchanging the digits is smaller than the original number by 63.
II. Sum of the digits is 11.

**41.** By selling a product for ₹100 how much profit was earned?

I. 20% profit would have been earned if it had been sold for ₹90.
II. The profit was one-third of the purchase price.

**42.** A train crosses another train running in the opposite direction in $x$ seconds. What is the speed of the train?

I. Both the trains are running at the same speed.
II. The first train is $y$ cm long.

**43.** The difference between the two digits of a number is 6. What is the number?

I. The digit at the units place is bigger than the other digit.
II. The sum of the two digits is 12.

**44.** $X$, $Y$ and $Z$ are integers, is $X$ an odd number?

I. An odd number is obtained when $X$ is divided by 5.
II. $(X + Y)$ is an odd number.

**45.** What is the capacity of a cylindrical tank?

I. Radius of the base is half of its height, which is 28 m.
II. Area of the base is 616 $m^2$. and height is 28 m.

**46.** What will be the compounded amount?

I. ₹200 were borrowed for 192 months at 6% compounded monthly.
II. ₹200 were borrowed for 16 years at 6%

**47.** What would have been the selling price per Kg of rice?

I. 50 Kg of rice was purchased for ₹3350 and ₹150 was spent on transport.
II. Profit earned was 5%

**48.** What will be ratio of men to women and children in the town?

I. Population of the town is 93280 of which 56100 are men.
II. The ratio of men to children is 5:2 and women are double in number than the children.

**49.** What will be the average weight of the remaining class?

I. Average weight of 30 children out of total 46 in the class is 22.5 Kg and that of the remaining children is 29.125 Kg. A child having weight more than 40 Kg is excluded.
II. Average weight of a class of 46 children is 23.5 Kg. A child weighing 46 Kg is dropped out.

**50.** What will be the number?

I. One-fifth of a number is equal to 20% of that number.

II. Thirty-five percent of a number is $\frac{7}{20}$ of that number.

**Directions (51–70)**: Each of the questions below consists of a question and three statements numbered I, II and III given below it. You have to study the questions and decide the data in which of the statements are sufficient to answer the questions.

**51.** What is the speed of the train '$A$'?

I. Train $A$ crosses 200-metre-long train $B$ running in opposite direction in 20 seconds.
II. Speed of the train $B$ is 60 Km/h.
III. Length of train $A$ is twice that of train $B$.
(a) I and II only (b) II and III only
(c) I and III only (d) All, I II and III
(e) Question cannot be answered even within formation in all three statements.

**52.** What is the area of the isosceles triangle?

I. Perimeter of the triangle is 14 m.
II. Base of the triangle is 14 m.
III. Height of the triangle is 5 m.
(a) I and II only
(b) II and III only
(c) I and II only or, II and III only
(d) I and III only
(e) All I, II and III

**53.** Who earns most among $M$, $N$, $P$, $Q$ and $R$?

I. $M$ earns less than $P$ but not less than $R$.
II. Q earns more than $M$ but not equal to $N$.
III. $N$ earns more than $M$ and $R$.
(a) Question cannot be answered even within formation in all three statements
(b) I and II only
(c) Only I and II or only I and III
(d) Only I and III
(e) All the three statements I, II, III together are necessary for answering the question

**54.** What is the price of 1 dozen oranges?

I. Price of 2 dozen oranges and 1 dozen banana is ₹110.
II. Price of 3 dozen apples and 1 dozen banana is ₹170.
III. Price of 1 dozen oranges and 1 dozen apples is ₹95.
(a) Only I and II or only I and III
(b) Only I and III or only II and III
(c) Only I and II or only II and III
(d) Only II and III
(e) All the three statements I, II and III necessary for answering the question.

**55.** The cost of carpeting a rectangular hall will be how much?

I. Perimeter of a rectangle is 60 m.
II. Angle between width and hypotenuse is 60°.
III. The cost of carpeting the surface floor is ₹125 per $m^2$.
(a) Only I and II
(b) Only II and III
(c) Only I and III or only II and III
(d) Question cannot be answered even within formation in all three.
(e) All the three statements I, II and III together are necessary for answering the question.

**56.** What is Sudha's present salary?

I. The salary increases every year by 15%
II. Her salary at the time of joining was ₹10000.
III. She had joined exactly 5 years ago.
(a) II and III only (b) I and II only
(c) All I, II and III (d) I and III only
(e) None of these

**57.** What was the amount of profit earned?

I. 10% discount was offered on the labelled price.
II. Had there been not discount, profit would have been 30%
III. Selling price was more than the cost price by 20%
(a) I and either II or III
(b) Any two of the three
(c) All I, II and III
(d) Either I or II and III
(e) Question cannot be answered even with the information in all three statements.

**58.** How many students are there in all in the institute of Arts, Commerce and Science?

I. 20% of the students study Science.
II. The numbers of students studying Arts and Commerce are in the ratio of 3:5.
III. The number of students studying Commerce is more than that studying Science by 375.
(a) II and III only
(b) III and either I or II only
(c) Any two of the three
(d) All I, II and III
(e) Question cannot be answered even with the information in all three statements.

**59.** What is the cost of flooring a rectangular hall?

I. Perimeter of the hall is 76 m
II. Area of the hall is 336 $m^2$.
III. Cost of flooring per square metre is ₹550.
(a) I and III only (b)II and III only
(c) Any two of the three (d)All I, II and III
(e) None of these

**60.** In how many days can a work be completed by *A* and *B* together?

I. *A* alone can complete the work in 8 days.
II. If *A* alone works for 5 days and *B* alone works for 6 days, the work gets completed.
III. *B* alone can complete the work in 16 days.
(a) Any two of the three
(b) II and either I or III
(c) I and II only
(d) II and III only
(e) None of these

**61.** What is the cost of flooring a rectangular hall?

I. The length and the breadth of the hall are in the ratio of 3:2.
II. The length of the hall is 48 m and the cost of flooring is ₹850 per $m^2$.
III. The perimeter of the hall is 160 m and the cost of flooring is ₹850 per $m^2$.
(a) Only I and II (b) Only I and III
(c) Only III (d) Only I and either II or III
(e) Any two of the three.

**62.** What is the rate of interest p.c.p.a.?

I. The amount doubles itself in 5 years on simple interest.
II. Difference between the compound interest and the simple interest earned on this amount in two years is ₹400.
III. Simple interest earned per annum is ₹2000.
(a) Only I
(b) Only II and III
(c) Any two of the three
(d) All I, II and III
(e) Only I or only II and III

**63.** What is a two-digit number?

I. The difference between the two-digit number and the number formed by interchanging the digits is 27.
II. The difference between the two digits is 3.
III. The digit at unit's place is less than that at ten's place by 3.
(a) Only I and II
(b) Only I and either II or III
(c) Only I and III
(d) All I, II and III
(e) Even with all the three statements the answer cannot be given.

**64.** What is the present age of Subir?

I. The present age of Subir is half that of his father.
II. After 5 years the ratio of Subir's age to his father'swill be 6:11.
III. Subir is 5 years younger than his brother.
(a) Only I and II (b) Only I and III
(c) Only II and III (d) All I, II and III
(e) Even with all the three statements answer cannot be given.

**65.** In how many days can 10 women finish a work?

I. 10 men can complete the work in 6 days.
II. 10 men and 10 women together can complete the work in $3\frac{3}{7}$ days.
III. If 10 men work for 3 days and thereafter 10 women replace them, the remaining work is completed in 4 days.
(a) Only I and II.
(b) Any two of the three
(c) Only I and III
(d) Only II and III
(e) None of these

**66.** In how many days can a work be completed by *A*, *B* and *C* together?

I. *A* and *B* together can complete the work in 6 days.
II. B and *C* together can complete the work in $3\frac{3}{4}$ days.
III. *A* and *C* together can complete the work in $3\frac{1}{3}$ days.
(a) Only I (b) Only II
(c) Only III (d) Anyone of the three
(e) Information in all the three statements is necessary to answer the question.

**67.** What is the cost of painting the two adjacent walls of a hall which has no windows or doors?

I. The area of the hall is 24 $m^2$.
II. The breadth, length and the height of the hall are in the ratio of 4:6:5.

III. Area of one wall is 30 $m^2$.

(a) Only I (b) Only II

(c) Only III (d) Either I or III

(e) Data inadequate.

**68.** What is the total compound interest earned at the end of three years ?

I. Simple interest earned on that amount at the same rate and for the same period is ₹4500.

II. The rate of interest is 10 p.c.p.a.

III. Compound interest for three years is more than the simple interest for that period by ₹465.

(a) OnlyI and II (b) Only II and III

(c) Only I and III (d) Anyone of the three

(e) Either II or III only.

**69.** What is the per cent profit earned by a shopkeeper on selling the articles in his shop?

I. Labelled price of the articles sold was 130% of the cost price.

II. Cost price of each article was ₹550.

III. A discount of 10% on labelled price was offered.

(a) Only I (b) Only II

(c) Only III (d) All the three are required.

(e) Question cannot be answered even with the information in all the three statements.

**70.** What is the average salary of 15 employees?

I. Average salary of 7 clerical cadre (out of the 15 employees) employees is ₹8500.

II. Average salary of 5 officer cadre (out of the 15 employees) employees is ₹10000.

III. Average salary of the 3 sub-staff employees (out of the 15 employees) is ₹2500.

(a) None (b) Only I

(c) Only II (d) Only III

(e) Question cannot be answered even within formation in all three statements.

**Directions (71–85)**: In each of the following questions, a question is asked followed by three statements. You have to study the questions and all the three statements given and decide whether any information provided in the statement(s) is/are redundant and can be dispensed with while answering the questions.

**71.** What will be the cost of fencing a circular plot? $\left(\pi = \frac{22}{7}\right)\cdots$

A. Area of the plot is 616 $m^2$.

B. Cost of fencing a rectangular plot whose perimeter is 120 m is ₹780.

C. Area of a square plot with side equal to the radius of the circular plot is 196 $m^2$.

(a) *A* only (b) C only

(c) *A* or C only (d) *B* only

(e) Question cannot be answered even within formation in all three statements.

**72.** What will be the sum of the ages of father and the son after five years?

A. Father's present age is twice son's present age.

B. After ten years the ratio of father's age to the son's age will become 12:7.

C. Five years ago the difference between the father's age and son's age was equal to the son's present age.

(a) *A* or *B* only (b) *B* or C only

(c) *A* or *C* only (d) *C* only

(e) *A* or *B* or *C* only

**73.** The difference between the compound interest and the simple interest at the same rate on a certain amount at the end of two years is ₹12.50. What is the rate of interest?

A. Simple interest for two years is ₹500.

B. Compound interest for two years is ₹512.50.

C. Amount on simple interest after two years becomes ₹5500.

(a) *A* or *B* only (b) *A* or *C* only

(c) *C* only (d) *C* and either *A* or *B*

(e) Any two of (*A*), (*B*) and (*C*)

**74.** 12 men and 8 women can complete a piece of work in 10 days. How many days will it take for 15 men and 4 women to complete the same work?

A. 15 men can complete the work in 12 days.

B. 15 women can complete the work in 16 days.

C. The amount of work done by a woman is three-fourth of the work done by a man in one day.

(a) *A* or *B* or C only (b) *B* or *C* only

(c) *C* only (d) Any two of the three

(e) *B* only

**75.** *P*, *Q* and *R* together invested an amount of ₹20000 in the ratio of 5:3:2. What was the per cent profit earned by them at the end of one year?

A. *Q*'*s* share in the profit is ₹2400.

B. The amount of profit received by *P* is equal to the amount of profit received by *Q* and *R* together.

C. The amount of profit received by *Q* and *R* together is ₹4000.

(a) *B* and *A* or *C* only (b) *A* or *C* only

(c) *A* and *B* both (d) *B* and *C* both

(e) Information in all the three statements is required to answer the question.

**76.** 8 men and 14 women are working together in a field. After working for 3 days, 5 men and 8 women leave the work. How many more days will be required to complete the work?

A. 19 men and 12 women together can complete the work in 18 days.
B. 16 men can complete two-third of the work in 16 days.
C. In a day, the work done by three men is equal to the work done by four women.
(a) Any two of the three together are sufficient
(b) *B* and *C* only (c) *C* only
(d) *B* or *C* only (d) *A* or *B* or *C*

**77.** Which is the area of the given right-angled triangle?

A. Length of the diagonal is 5 cm.
B. Perimeter of the triangle is four times its base.
C. One of the angles of the triangle is of 60°.
(a) *C* only (b) *A* and *C* only
(c) *B* or *C* only (d) *B* and *C* both
(e) *A* or *B* or *C*

**78.** Three friends *X*, *Y* and *Z* started a partnership business investing money in the ratio of 5:4:2, respectively for a period of 3 years. What is the amount received by *X* as the share in the total profit?

A. Total amount invested in the business is ₹22000/-.
B. Profit was distributed after a period of 2 years.
C. The average amount of profit earned per year is ₹2750.
(a) *A* only (b) *B* only
(c) *C* only (d) *A* or *C* only
(e) *A* or *B* or *C*

**79.** How much time will the train '*X*' take to cross another train '*Y*' running in opposite direction?

A. Train '*X*' crosses a signal pole in 6 seconds.
B. Ratio of the speeds of trains '*X*' and '*Y*' is 3:2.
C. Length of the two trains together is 500 m.
(a) *A* only (b) *B* only
(c) *C* only (d) *A* and *B* only
(e) The question cannot be answered even with the information in all the three statements.

**80.** What will be the cost of painting the four walls of a room with length, width and height 5 m, 3 m and 8 m respectively? The room has one door and one window.

A. Cost of painting per $m^2$ is ₹25.00
B. Area of window of 2.25 $m^2$ is half of the area of the door.
C. Area of the room is 15 $m^2$.
(a) *A* only (b) *B* and *C* together
(c) *A* and *B* together (d) *C* only
(e) All are required to answer the question.

**81.** What is *R*'s share of profit in a joint venture?

A. *Q* started a business investing ₹80000/-.
B. *R* joined him after 3 months.
C. *P* joined after 4 months with a capital of ₹120000 and got ₹6000 as his share of profit.
(a) Only *A* and *C* are required
(b) Only *B* and *C* are required
(c) All *A*, *B* and *C* together are required
(d) Even with all *A*, *B* and *C* the answer cannot be arrived at.
(e) None of these

**82.** What is the area of a right-angled triangle?

A. The perimeter of the triangle is 30 cm.
B. The ratio between the base and the height of the triangle is 5:12.
C. The area of the triangle is equal to the area of rectangle of length 10 cm.
(a) Only *B* and *C* together are required
(b) Only *A* and *B* together are required
(c) Only either *A* or *B* and *C* together are required
(d) Only *A* and *C* together are required
(e) None of these

**83.** What is the sum of two numbers?

A. The bigger of these two numbers is 6 more than the smaller number.
B. 40% of the smaller number is equal to 30% of the bigger number.
C. The ratio between half of the bigger number and one-third of the smaller number is 2:1.
(a) Only *B* and C together are required
(b) Only *A* and *B* together are required
(c) Any two of *A*, *B* and *C* together are required
(d) All *A*, *B* and *C* together are required
(e) None of these

**84.** How many marks did Arun get in English?

A. Arun secured an average of 60 marks in four subjects including English.
B. He secured a total of 170 in English and Mathematics together.
C. He secured a total of 180 in Mathematics and Science together.
(a) All *A*, *B* and *C* together are required
(b) Only *A* and *B* together are required

(c) Only $B$ and $C$ together are required
(d) Only $A$ and $C$ together are required
(e) None of these

**85.** What was the profit earned on the cost price by Mahesh by selling an article?

A. He got 15% concession on labelled price in buying that article.
B. He sold it for ₹3060/-
C. He earned a profit of 2% on the labelled price.

(a) Only $A$ and $B$ together are required
(b) Only $B$ and $C$ together are required
(c) Only either $A$ or $C$ and $B$ together are required
(d) Even with all $A$, $B$ and $C$ the answer cannot be arrived at.
(e) All $A$, $B$ and $C$ together are required.

## ANSWER KEYS

### EXERCISE-I

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (a) | **2.** (e) | **3.** (d) | **4.** (e) | **5.** (c) | **6.** (d) | **7.** (b) | **8.** (e) | **9.** (e) | **10.** (e) | **11.** (c) | **12.** (e) | **13.** (a) |
| **14.** (b) | **15.** (e) | **16.** (d) | **17.** (b) | **18.** (e) | **19.** (d) | **20.** (c) | **21.** (d) | **22.** (e) | **23.** (d) | **24.** (e) | **25.** (d) | **26.** (d) |
| **27.** (d) | **28.** (c) | **29.** (e) | **30.** (d) | **31.** (a) | **32.** (e) | **33.** (c) | **34.** (c) | **35.** (d) | **36.** (e) | **37.** (a) | **38.** (d) | **39.** (c) |
| **40.** (e) | **41.** (c) | **42.** (d) | **43.** (e) | **44.** (a) | **45.** (c) | **46.** (c) | **47.** (e) | **48.** (b) | **49.** (b) | **50.** (d) | **51.** (d) | **52.** (b) |
| **53.** (a) | **54.** (e) | **55.** (e) | **56.** (c) | **57.** (e) | **58.** (d) | **59.** (b) | **60.** (a) | **61.** (e) | **62.** (e) | **63.** (e) | **64.** (a) | **65.** (b) |
| **66.** (e) | **67.** (e) | **68.** (d) | **69.** (b) | **70.** (b) | **71.** (c) | **72.** (e) | **73.** (e) | **74.** (d) | **75.** (a) | **76.** (e) | **77.** (b) | **78.** (d) |
| **79.** (e) | **80.** (d) | **81.** (d) | **82.** (b) | **83.** (e) | **84.** (e) | **85.** (e) | | | | | | |

## EXPLANATORY ANSWERS

### EXERCISE-I

**1.** **(a)** From statement I,
Ratio of the costs of first, second and third necklace is 6:5:7.
Hence, the price of second necklace can be calculated.

**2.** **(e)** From Statement I,

Rate of an item $= \dfrac{4500}{x}$ ...(1)

Here, $x$ = total number of items
Combining statement II and (i), we have

$$\left(\frac{4500}{x}+5\right)(x-10)=4500$$

or, $x^2-10x-9000=0 \quad \therefore \quad x=100$

Hence, both statements together are sufficient

**4.** **(e)** Combining statements (I) and (II),
$l^2 + b^2 = 9000$

$$\frac{25}{9}b^2+b^2=900 \quad \therefore \quad b=15 \text{ m and } l=25 \text{ m}$$

$\therefore$ Area = 375 m$^2$.

**5.** **(c)** From statement I,
32% + 1 = 36% − 1 = Minimum pass marks
$\therefore$ Minimum pass marks = 17
From statement II,
Minimum pass marks = 30% + 2 and
(40 − 30)% = 5 $\therefore$ 30% = 15
$\therefore$ Minimum pass marks = 15 + 2 = 17
Hence, either $A$ or $B$ alone is sufficient.

**6.** **(d)** From the statement I, we will get the sum of length and breadth, but we need individual values of length and breadth.

7. **(b)** I → $B - G = 40$

II → $G = 80\%$ of $B = \frac{4}{5}B$

∴ $B:G = 5:4$

8. **(e)** I → $a = 60\%$ of $b$,

where $a$ and $b$ are the first and second numbers, respectively.

$$a = \frac{6}{10}b,$$

II →7 $(a + b)50\% = 24$ ∴ $a + b = 48$

After combining these two statements we get the difference between two numbers as 12.

9. **(e)** Combining both the statements, we get the speed of

$$\text{train} = \frac{180+120}{4} \times \frac{18}{5} = 270 \text{ Km/h.}$$

10. **(e)** I → $R = 5\%$

II → $(CI - SI)$ for two years = ₹20

Combining I and II and using

$$\text{Sum} = \frac{\text{Diff} \times 100 \times 100}{\text{Rate} \times \text{Rate}} = \frac{20 \times 100 \times 100}{25}$$

$$= ₹8000$$

$$\text{So, CI} = 8000\left(1+\frac{5}{100}\right)^3 - 8000 = ₹1261.$$

11. **(c)** I → Number of boys in the class $= \frac{4}{9} \times 45 = 20$

II → $\frac{B}{G} = \frac{5}{4}$ and $B - G = 9$

Solving, the above two, we get $B = 45$.

12. **(e)** I → $M = 1,250$ and $F = 1050$

II → $M:F = 2:1$

On combining both the statements,

$$\text{Average} = \frac{2K \times 1250 + K \times 1050}{3K} = \frac{2500+1050}{3}$$

$$= 1183.33.$$

13. **(a)** 1 → $m = 999999$, $n = 1000000$

∴ $m - n, 37 = 999999 - 1000000 \div 37$

$= 999999 - 2702.70 = 997296.30$

II → $m - n$ = known, but neither the value of '$m$' is known nor the value of '$n$' is known. So, we cannot find the value of $m - n + 37$ by this statement.

14. **(b)** I → The fixed value of CP is not given, so SP of the article cannot be determined.

II → Let, $x$ be SP of an article

$$x \times \frac{90}{100} = \frac{200 \times 115}{100} \quad \therefore \quad x = \frac{200 \times 115}{90} = ₹255.55.$$

15. **(e)** I → Area of the room = $9 \times 7 = 63$ m$^2$

$$\text{II} \rightarrow \text{Rate} = \frac{\text{Cost of polishing the floor}}{\text{Area of floor}}$$

$$= \frac{112.50}{10 \times 5} = 2.25 \text{ per m}^2$$

∴ Combining both the statements, cost of polishing the rectangular floor = $63 \times 2.25$ = ₹141.75.

16. **(d)** I. $M + ph + ch = 165\%$

II. $Pr \rightarrow M + 10\%$ (average)

17. **(b)** I. CI in two years = ₹820

$$\text{II. Rate} = \frac{250}{5000} \times 100 = 5\%$$

18. **(e)** I. $x - y = \frac{1}{3}x$, or, $2x - 3y = 0$

II. $x + y = 30$

By combining I and II, we get $y = 12$.

19. **(d)** I. Area of right-angled triangle = $12 \times L$

II. $L = 18$ cm.

∴ By combing I and II we can find the area of right-angled triangle, but the height cannot be determined in absence of the base of the triangle.

21. **(d)** For solving this question, we want two equations in terms of $P$ and Q.

22. **(e)** Combing both the statements together, let the labelled price be ₹100.

Now, SP of the suitcase = 125% of 100 = ₹125

$$\therefore \quad \text{Labelled price} = \frac{2000}{125} \times 100 = ₹1600$$

$$\therefore \quad \text{CP of the suitcase} = 1600 \times \frac{3}{4} = ₹1200.$$

23. **(d)** Here, we do not know the type of triangle. If the triangle is right-angled, then the height can be determined with the help of statement I alone.

24. **(e)** Combining both the statements together,

$$\text{Rate of interest} = \frac{800}{2 \times 8000} \times 100 = 5\%$$

26. **(d)** Here, neither the speed of the train nor the individual length of the train is given. Hence, (d) is the correct answer.

27. **(d)** When we combine statements I and II together, we can find the area of the triangle, which is also the area of the rectangle. But without knowing the breadth of the rectangle, length of the rectangles cannot be determined.

**28.** **(c)** I. $\rightarrow$ Rate of interest $=\dfrac{100}{1000}\times 100=10\%$

$\therefore$ CI at the end of 3 years $=1000\times\dfrac{33.1}{100}=₹331$

II. $\rightarrow$ Rate of interest $=\sqrt{\dfrac{10\times 100\times 100}{1000}}=10\%$

$\therefore$ CI at the end of 3 years $=1000\times\dfrac{33.1}{100}=₹331.$

**29.** **(e)** Let, the two-digit number be $10x+y(y<x)$

I. $x-y=5$

II. $x+y=7$

When we combine both statements together value of '$x$' and '$y$' can be determined. Hence, both statements together are sufficient to answer the question.

**30.** **(d)** Let, the distance between $A$ and $B$ be $D$ Km and the speed of the boat and current in still water be $x$ Km/h and $y$ Km/h, respectively.

I. $\rightarrow D=(x-y)^2$

II. $\rightarrow D=(x-y)^4$

Even if we combine both statements, we cannot find out the answer, because we have two equations and three variables.

**31.** **(a)** I. $R=(3-1)\times\dfrac{100}{20}=10\%$

II. Here, the sum is not given. Therefore, statement I alone is sufficient.

**32.** **(e)** From I, we can calculate the SI after 5 years. When we combine with II, we can get the value of the sum.

i.e., $(P+5000)=2P$ or, $P=₹5000$.

**33.** **(c)** Let, the length of the train be '$d$' m.

Speed of the tram $=\dfrac{d}{X}$

I. We know that when a train crosses a platform, it crosses not only its length but also the length of the platform.

i.e., $\dfrac{d}{X}=\dfrac{d+100}{Y}$ or, $d=\dfrac{100X}{Y-X}$

II. Length of the train ($d$) $=80\times\dfrac{5}{18}X=\dfrac{200X}{9}$

Therefore, either I alone or II alone is sufficient to answer the question.

**34.** **(c)** I. Radius of circle $=\dfrac{308\times 7}{2\times 22}=49$ m

Area of circle $=\dfrac{22}{7}\times 49\times 49=7546\text{ m}^2$

II. Area of circle $=\dfrac{22}{7}\times 28\times 28=2464\text{ m}^2$

Hence, either I alone or II alone is sufficient for answering the question.

**35.** **(d)** I. $A+B$ is odd $\Rightarrow$ If $A$ is an even number then $B$ will be an odd number and vice versa.

II. $C+B$ is odd $\Rightarrow$ if $B$ is an even number then C will be an odd number and vice versa.

So, even by combining the two statements together, we are not able to say that $B$ is an even integer.

**36.** **(e)**

**From I**: Ratio of boys and girls = $3k:4k$

**From II**: Number of girls − Number of boys = 18

**From I and II**: $4k-3k=18$ $\therefore$ $k=18$

$\therefore$ $4k+3k=18\times 7=126$.

**37.** **(a)** Only I alone is sufficient.

**38.** **(d)** To find out the cost of laying carpet we need (i) cost of carpet per $\text{m}^2$ and, (ii) Area of the floor tobe carpeted. Both the information even together are not sufficient to fulfil our need.

**39.** **(c)** We know, if we have been given difference of CI and SI during two years, then this difference ($D$) is equal to

$\dfrac{P\times r^2}{100^2}$

where, $P$ = Principal, $r$ = rate of interest

**From I**: We get the value of $P$ and $D$. Hence, I alone is sufficient.

Again, we known SI $=\dfrac{P\times r\times T}{100}$

where, $P$ = principal

$r$ = rate of interest

$T$ = time period

**From II**: We get value of $P=x$(say).

Then, SI = $x$ and $T=6\dfrac{2}{3}$ years

Hence, using the above formula we can get rate of interest from II alone also.

**40.** **(e)** Suppose units place of number is occupied by $y$ and tens place by $x$.

**From I**: $(10x+y)-(10y+x)=63$

$\Rightarrow$ $9x-9y=63$

$\Rightarrow$ $x-y=7$ $\cdots(1)$

**From II**: $x+y=11$ $\cdots(2)$

From equations (i) and (ii), $x=9$, $y=2$

Hence, required number = 92

Basically, to answer these type of questions we need the following information:

A. Difference of units and tens digits of the two-digit number.

B. Sum of units and tens digits.

C. Comparison of the value of units and tens digits.

With the help of the information in statements I and II together we get the required information.

**41.** **(c)** I. CP $= 90 \times \frac{100}{120} = ₹75$

Profit = 100 − 75 = ₹25

II. SP = CP + Profit

or, $x + \frac{x}{3} = 100$ or, $x = \frac{100 \times 3}{4} = 75$

∴ Profit = 75/3 = ₹25

Therefore, either statement I or II alone is sufficient to answer the question.

**42.** **(d)** The length of the other train is not given inany of the statements.

**43.** **(e)** Let, the digits be $x$ and $y$. We are given $x - y = 6$ (Assume $x > y$)

**From statement I**: $x$ occupies units place

**From statement II**: $x + y = 12$

With the help of information in the question part and in statement II, we can find the value of $x$ and $y$ easily because there are two equations to know about two unknowns. But to determine the number we need the help of statement I.

**44.** **(a)** Statement I alone is sufficient to answer the question .We know that whenever any odd number is divided by any odd number, it gives an odd number.

**45.** **(c)** We know the capacity of a cylindrical tank can be found out by using the following formula:

Area of the base of cylinder × height of cylinder or, 10 $r^2 \times h$, where $r$ = radius of cylinder

$h$ = height of cylinder

Now,

Statement I gives the value of r and $h$. Hence, statement I alone is sufficient. Again, statement II gives information about area of the base and height. Hence, statement II alone is also sufficient.

**47.** **(e)** $\text{SP} = \dfrac{(3350 + 150) \times \frac{105}{100}}{50}$ per kg.

**48.** **(b)** Ratio of men:women:children = 5:4:2

**51.** **(d)** I. $V_A + V_B = \dfrac{D_A + 200}{20}$

II. $V_B$ = 60 Km/h

III. $D_A$ = 2 ₹200 = 400 m.

Putting the values of II and III in I, we get the value of $V_A$ = 48 Km/h.

**52.** **(b)** I. $a + b + c = 14$ where, $b = c$

II. $a$ = 14 cm

III. $h$ = 5 cm

So, by combining I and II, we are getting the values of $b$ and $c$ as zero, which is not possible. So, only by combing II and III we get the value of the area, which is equal to 35 cm$^2$.

**53.** **(a)** I. $P > M$, $M > R$ or, $M = R$

II. $Q > M$, $Q > N$ or, $Q < N$

III. $N > M/R$

So, by combining anyone with the other or even by combining all, we cannot reach any conclusion about who earns most.

**54.** **(e)** Let, the price of 1 dozen oranges, 1 dozen banana and 1 dozen apples be $x$, $y$ and $z$, respectively.

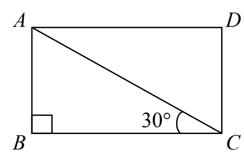
I. $2x + Y = 110$

II. $3z + Y = 170$

III. $x + z = 95$

So, by combining all, we get the values of $x = 45$.

**55.** **(e)**




I. 2 $(L + b)$ = 60

∴ $L + b = 30$ ···(1)

II. In Δ$ABC$

$\tan 30° = \frac{b}{L}$ ∴ $L : b = \sqrt{3} : 1$

Combining I and II, we get the value of $L \approx 19$ and $b \approx 11$ m

∴ Area of rectangle = 19 × 11 = 209 m$^2$

III. Cost = ₹125 per m$^2$

∴ total cost of carpeting = 125 × 209 = ₹26125.

**56.** **(c)** By combining all the three statements together,

Sudha's present salary $= 10000\left(1 + \frac{15}{100}\right)^5$.

**57.** **(e)** None of the statements give the amount of labelled price or SP. So, even by combining all the statements together, question cannot be answered.

**58.** **(d)** Statements I and II give the percentage number I of students studying in different disciplines. Combining this with (iii), the total number of students can be determined.

**59.** **(b)** Combining (ii) and (iii),

total cost = 336 × 550 = ₹184800.

**60.** **(a)** With the help of I and II, part of work done by $A$ in 5 days $= \frac{5}{8}$, Remaining $= \frac{3}{8}$

Therefore, $B$ alone can do the work in $6\times\frac{8}{3}=16$ days

$\therefore\quad A+B=\frac{8\times16}{24}=\frac{16}{3}$ days

Similarly, by combining any two of the three, the required number of days can be determined.

**61.** **(e)** With the help of any two statements, the value of length and breadth can be calculated. And, combing this with the cost per m$^2$ we get the total cost of flooring the rectangular hall.

**62.** **(e)** **From I alone,**

Rate of interest $=\frac{(2-1)\times100}{5}=20\%$

**From II and III,**

Rate of interest $=\frac{2\times \text{ diff. in CI and SI}}{\text{SI}}$

[For 2 years only]

$=\frac{2\times400}{4000}\times100=20\%$

Hence, either I alone or II and III together are sufficient.

**63.** **(e)** Let, the two-digit number be $10x + y$.

I. $\Rightarrow$ $|\,10x + y - 10y - x\,| = 27$ or, $|x - y\,| = 3$

II. $\Rightarrow$ $|x - y\,| = 3$

III. $\Rightarrow$ $x - y = 3$

Here, by taking any two, the values of $x$ and $y$ cannot be determined. So, choice (e) is the correct answer.

**64.** **(a)** Let, the present age of Subir and his father be $S$ and $F$, respectively.

I. $S = F/2$

II. $\frac{S+5}{1+5}=\frac{6}{11}$ or, $6F-11S=25$

III. $B - S = 5$[$B$ = age of Subir's brother]

Now, with the help of I and II together, the value of $S$ and $F$ can be determined.

**67.** **(e)** Cost of painting is not given, hence data inadequate.

**68.** **(d)** Let, the sum be ₹$x$

**From the statements, I and II**

$\frac{x\times10\times3}{100}=4500\quad\Rightarrow\quad x=₹15000$

$\therefore\quad \text{CI}=15000\left(1+\frac{10}{100}\right)^3-15000$

$= 19965 - 15000 = ₹4965$

**From the statements, I and III,**

CI − SI = 465

$\therefore$ CI = 465 + 4500 = ₹4965

**From the statements, II and III,**

CI = ₹4965

Hence, any of them can be dispensed with.

**69.** **(b)** **From the statements, I and II,**

Let, the cost price of the article be ₹100.

$\therefore$ Labelled price = 130

$\therefore\quad SP=130\times\frac{90}{100}=₹117$

Hence, II can be dispensed with.

**71.** **(c)** (B) is necessary because only this statement gives the rate of fencing. Anyone of (A) or (C) gives the value of radius, which enables us to find the circumference.

Hence, either (A) or (C) can be dispensed with.

**72.** **(e)** Any two of the three statements are sufficient to answer the question (As to find the two unknowns we need two equations). Hence, anyone of the statements can be dispensed with.

**73.** **(e)** Anyone of the three statements is alone sufficient to answer the question. So, any two can be dispensed with.

**From (A) alone**:

$\text{Rate}=\frac{(\text{CI}-\text{SI})\times2}{\text{SI}}\times100=\frac{25}{500}\times100=5\%$

**From (B) alone**:

CI = ₹512.5

$\therefore$ SI = ₹512.5 − ₹12.5 = ₹500

Again, Rate

$=\frac{(\text{CI}-\text{SI})\times2}{\text{SI}}\times100$

$=\frac{25}{500}\times100=5\%$

**From (C) alone**:

Suppose Principal = $P$ and Rate of Interest = $r$%

$$\text{Then, } P\left(1+\frac{r}{100}\right)^2=5500+12.5=5512.5\qquad\cdots(1)$$

$$\text{and, } P+\frac{2rP}{100}=5500$$

$$\text{or, } P\left[1+\frac{2r}{100}\right]=5500\qquad\cdots(2)$$

Dividing (1) by (2) we have

$$\frac{\left(1+\frac{r}{100}\right)^2}{1+\frac{2r}{100}}=\frac{5512.5}{5500}\qquad\cdots(3)$$

This is a quadratic equation which has only one variable, $r$. It can be solved. Hence, value of $r$ can be obtained.

Note: is satisfied with the value $r = 5$.

So, it confirms that equation is solvable.

**75.** **(a)** Statement *(B)* is useless because it is the same as the given statement. [Profit is distributed in the same ratio as their investment. Since their investments are in ratio 5:3:2, the profit of $P$ (= 5) is equal to the profit of $Q$ and $R$ together (3 + 2 = 5)]

Statement (A) alone is sufficient to answer.

(Q's share = ₹2400

$$\text{Total profit of } P+Q+R = \frac{2400}{3}\times(5+3+2)$$
$$= ₹8000$$

$$\therefore \quad \%\text{ profit} = \frac{8000}{20000}\times 100 = 40\%$$

Similarly, statement (C) alone is sufficient to answer the question.

Hence, (B) and (A) or (C) can be dispensed with.

**77.** **(b)** Let, the length and breadth of the rectangle be $l$ and $b$, respectively.

$A \rightarrow l^2 + b^2 = 25$

$B \rightarrow l + b + h = 4b$ or, $l = 3b - 5$

C $\rightarrow$ Ratio between $l$ and $b$ is given. After combining any of the above two statements, we get the values of $l$ and $b$. Hence, any of them can be dispensed with.

**78.** **(d)** When investment ratio is given, the amount of profit can be found out with the help of $C$ only.

**80.** **(d)** The area off our walls can be easily determined with the help of the data given in the question. Now,the area of the windows and door with the help of ($B$) can be subtracted in the calculated area and then multiplied with the cost given in (A).

**81.** **(d)** Investment ratio or amount is not given, hence even all statements together are not sufficient.

**82.** **(b)** Let, the base, height and hypotenuse of a right-angled triangle be $b$, $p$ and $h$, respectively.

**From A,** $b + P + h = 30$ $\cdots(1)$

**From B,** $b:p = 5:12$ $\cdots(2)$

We know that

$h^2 = p^2 + b^2 = 25x^2 + 144x^2 = 169x^2$

$\therefore \quad h = 13x$ $\cdots(3)$

Combining equations (i), (ii) and (iii), we get

$5x + 12x + 13x = 30 \quad \Rightarrow \quad x = 1$

$$\therefore \quad \text{Area of triangle } = \frac{1}{2}\times 5\times 12 = 30 \text{ cm}^2$$

Hence, only $A$ and $B$ together are sufficient.

**83.** **(e)** Let, the bigger and smaller numbers be $x$ and $y$, respectively.

**From A,** $x - y = 6$

**From B,** 40% of $y$ = 30% of $x$ or; $4y = 3x$ $\cdots(2)$

**From C,** $\frac{x}{3}:\frac{y}{3} = 2:1$ or, $3x = 4y$ $\cdots(3)$

We see tha equations (ii) and (iii) are same. Hence, $A$ and either $B$ or C is required.

**85.** **(e)** **From A and B,**

$$\text{Labelled price} = \frac{3{,}060\times 100}{85} = ₹36000 \qquad \cdots(1)$$

**Combining (i) and Statement C,**

$$\text{Profit} = 36000\times\frac{2}{100} = ₹72 \qquad \cdots(2)$$

**Combining (ii) and Statement B,**

CP = 3,060 − 72 = ₹2988

$$\therefore \quad \%\text{ profit} = \frac{72}{2988}\times 100 = 2.40\%$$

Hence, all statements are required.